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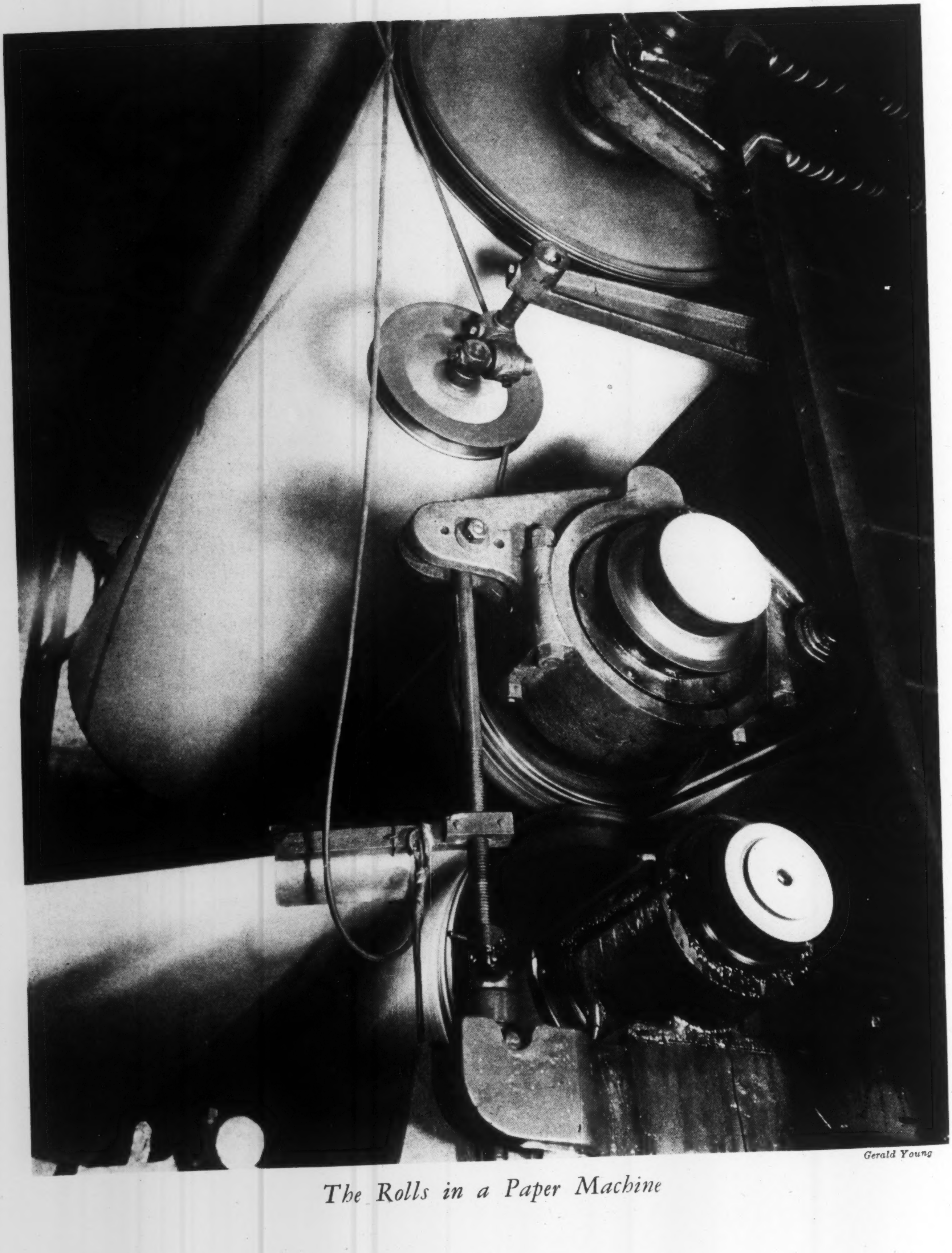

Gerald Young

The Rolls in a Paper Machine

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MECHANICAL ENGINEERING

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GEORGE A. STETSON, *Editor*

Plastics

SINCE the war, with the rapid growth of industrial chemistry, plastics have increased rapidly in number and variety, with the result that many of the older and more familiar materials are rapidly being replaced and the designer finds it necessary to adapt his designs to make use of them. He finds in these synthetic materials greatly enlarged possibilities of providing superior and more attractive products and is forced to consider changes in his art to make best use of them. So rapidly does the field develop that constant study is demanded of him lest competitors seize the markets he tries to serve. Similarly, the shop man is forced to introduce new machines and processes for products made of plastic materials, and those who design and manufacture production tools are faced with the necessity of keeping up with the chemist and the demands of the public. Finally, to make the changed conditions more pronounced, industrial artists have discovered a greater field for their services, and a new and important element of design is demanding increasing attention.

In a symposium on plastics, under the sponsorship of the Machine Shop Practice Division, four phases of this new technique are to be discussed at the 1937 Annual Meeting of The American Society of Mechanical Engineers—the plastic materials themselves, the demands their use makes of designers, the growing importance of the function of the industrial artist, and the new machines by which these materials are molded into products for the market. Papers covering the first three of these subjects are to be found in this issue, and represent the first important contribution to the Society's literature. Promise that the fourth paper, on machinery, will be available for a later issue, has been made. The Machine Shop Practice Division is to be congratulated for having made available this significant group of papers.

Magazines devoted to industrial chemistry and to the new art of plastics have been informing designers, manufacturers, and the public about these new and numerous materials for several years. Manufacturers of plastics have provided descriptions of their products and data on their physical, chemical, electrical, and other properties, and have been aggressive in developing new applications and attractive examples of their possibilities and market appeal. Whatever his field, the engineer cannot remain indifferent to this remarkable progress, and designers particularly cannot study these new materials too thoroughly. As supplemental reading to the papers offered at the A.S.M.E. symposium, attention is called to the October, 1937, issue of *Modern Plastics*, the annual catalog and directory number, in which a vast amount of reference material is made available. In this connection it may be noted that *Modern Plastics* is a beautiful example of the presswork of the shop in which MECHANICAL ENGINEERING is also produced.

Weights and Measures

A RECENT report that in Germany the quandrant is henceforth to be divided into 100 rather than the customary 90 parts calls attention once more to century-old controversies about decimalization and the metric system. Whether the head of a family of five in the Reich will derive any comfort in being able to divide a pie (if they serve pie abroad) into uniform portions of 80 rather than 72 units each is problematical, but the confusion that will inevitably result in interpreting land records seems to be quite certain, if we are to believe Walter Renton Ingalls who makes a good argument based on the cost of such confusions in his recent monograph, "Modern Weights and Measures."

The English speaking peoples have never taken kindly to the metric system for certain realistic reasons which Mr. Ingalls advances. In our own country, in spite of the fact that such a "reform" has been sponsored on numerous occasions during a period of more than a century, and by eminent persons at that, we have as yet gone no further than to make use of the metric system permissive, thus avoiding what many would consider a major calamity—a compulsory change having far-reaching economic consequences.

Mr. Ingalls, who is president of the American Institute of Weights and Measures, publishers of the monograph, has presented an easily read and informative exposition of the metric-system controversy within the compass of 72 pages (thus resisting the impulse, to which a disciple of decimalization might have yielded, to round them out to a neat multiple of 10). Starting with a historical résumé he offers some comparisons between the English and metric systems, discusses the difficulty of changing from one system to another (even in metric France nonmetric systems still persist), exposes and replies to prometric propaganda, brief arguments for the system and refutes the arguments, shows how impracticable it would be to effect a change in this country, discusses the United States Law of 1866 in which the metric system was made permissive, has some things to say about refinement in measurements, quotes a prometric letter of John Hays Hammond and his own views written in comment on those of the eminent mining engineer, and concludes with a brief convenient summary of his subject matter.

Why Collect Books?

LIKE the sermon on the Prodigal Son, said to be so frequently preached at penitentiaries, exhortations to college men to read good books and to engineering students to develop a broad culture get threadbare. It is hard to say anything new on these subjects, but every so often someone hits on an approach that is more effective than preaching.

Several years ago, for example, Byrne Hackett opened a bookshop in New Haven that probably was quite as potent a force in creating a love for books and a desire to collect them as any exercised in the classrooms of the college. Hackett encouraged young men to come into his attractive shop to browse, communicated to them his enthusiasm for books as something to be prized and owned, and showed them how, for modest investments, a library of what some day would be first editions, collections of books covering a certain field, or of the works of a few favorite authors, could initiate a lifelong hobby from which an increasing amount of satisfaction might be derived. Many a book collector has started his career in Mr. Hackett's bookshop located in High Street where the huge mass of the Sterling Library now stands.

At Purdue University, W. H. Winterrowd, member, A.S.M.E., has fathered another device directed to the same end by establishing a book-collecting contest, with a yearly prize offered to the senior who has formed the best personal collection of books. A committee, of which H. L. Creeks, of the Department of English and Speech, is chairman, inspects the collections and makes the award. The winning "library" and the more interesting collections are exhibited each year in the university library and the award is made at the close of the year at a Literary Dinner, when prizes are also given for literary achievements in the writing of essays, plays, poems, and stories.

One hundred dollars, the amount of the award, will buy a respectacle number of books to augment the winning collection, but the lucky student wins more than money. He is, without doubt, well-established in a habit and a hobby from which, as years advance, cares multiply, and the more exacting pleasures of youth pale or must be given up, satisfaction streams with increasing abundance. Mr. Winterrowd's enthusiasm and the private library this enthusiasm has built up are well-known to his friends, and in the Purdue award he is making a very practical contribution to that culture of engineers so many of us preach about to young men. In later years, when the graduates of Purdue who have caught this enthusiasm withdraw for a few quiet hours in whatever sanctuary their growing collections of books may find a home, be it a comfortable library or their only living quarters, they will bless the man who awakened in them a sense of appreciation, not only of reading, but of books stamped with the personality that comes with possession. Fortified with the wisdom and beauty that are locked up within the covers of books, awaiting only the attention of the reader to unloose them, the book collector is certain to experience many hours of complete detachment from whatever cares and discouragements dog his days. Then and there he learns for himself the answer to the question, "Why Collect Books?" which Mr. Winterrowd uses as the title of a little booklet he has written in connection with his Purdue awards.

Junior Group News

AT ITS meeting in October the Committee on Publications of The American Society of Mechanical Engineers authorized the appointment of Louis N. Rowley, Jr., as editor of junior-group news for the A.S.M.E. News Section of MECHANICAL ENGINEERING. Readers who have followed the news relating to activities of junior groups organized in numerous local sections of the Society will appreciate the reasons for Mr. Rowley's appointment, and will accept the appointment as another indication that the Society has the interests of its younger members at heart.

Attention has frequently been called to the significance and importance of the forces that are at work today in groups of junior members pursuing active programs of development in various parts of the country. It is an encouraging sign of virility in the engineering profession that so many young men are determined not only to associate themselves with older men who have long been practicing in the field but also to set up activities of their own group in which they can benefit by actual participation in affairs that lie close to their immediate interests. Men so engaged at the outset of their careers can be counted upon to provide a high quality of leadership and mutually helpful service in later years, when the burden of maintaining the Society and its ideals falls directly upon their shoulders.

Through MECHANICAL ENGINEERING one means is offered to junior groups of coordinating their several activities and mutually benefiting one another by interchange of ideas for programs of development. A knowledge of what others are doing frequently has the effect of stimulating interest, encouraging leadership, and convincing the apathetic or those whose enthusiasm may flag. Hence, if Mr. Rowley and MECHANICAL ENGINEERING are to be of maximum service to the junior-group movement, it is essential that every group cooperate toward that end. It will be Mr. Rowley's task, in consultation and with the aid of the Society's officers and committees, to make best use of material sent to headquarters for the junior-group news and to see that ideas and suggestions that may come as a by-product of his editorial function are passed on to those whose responsibility it is to consider them.

The Place of the ENGINEER *in* MODERN LIFE

By HARVEY N. DAVIS

PRESIDENT, STEVENS INSTITUTE OF TECHNOLOGY

SO MUCH has been written and said during the last twenty years about the place of the engineer in modern life, about the fundamental rôle that he plays both in developing and in maintaining the material foundations of modern civilization, about the advantages, and also the dangers, of the machine age that he has inaugurated, about the Frankenstein problems that he has unconcernedly foisted upon a generation utterly unable to cope with them, and about the obligation that rests upon him to stop inventing machines and turn his almost legendary energy and skill to inventing institutions that will constitute a solution of the problems he has raised, and contrarywise, about his utter inability to offer wise or useful counsel in fields outside the narrow boundaries of his technical training, that it has been hard to decide to which aspect of this vast subject I should invite your attention during the few moments that are appropriate to an address of this sort. I have finally decided to confine myself to the one part of it which is of particular interest to me as a teacher of engineering cadets.

A hundred years ago the engineers of the world were almost exclusively expert technicians. They were building roads and bridges and canals. The steam engine had only recently attained a status of practical usefulness and they were busy learning how to build it in various forms and sizes accurately enough and cheaply enough to bring it into widely diversified service. They were also busy developing the textile and other machinery which it was to drive, and designing and building the mills and factories to house that machinery. And most of all they were busy developing the machine tools that alone could make considerable progress possible either in the generation or in the utilization of power. Furthermore, railroads had only recently begun to rival canals as a means of wholesale transportation and the engineers of a hundred years ago were barely beginning the long job of conquering the wilderness with their twin strands of iron, and of developing and improving the locomotives and cars that were to run on them. It was a frontier-conquering era, in an intellectual as well as in a geographical sense; and sufficient technical skill, knowledge, and experience were rare and highly valued. It was natural, therefore, that so many of the engineering schools that sprang up in the middle half of the last century should have been called schools of technology or polytechnic institutes, and that their major objective should have been to teach the technique of engineering.

This conception of the engineer as a master technician is still the overwhelmingly prevalent one in the public mind. And it is indeed a noble as well as a romantic conception. It is a conception that led Emil Ludwig to write in a magazine article some years ago, "The century above all else, determines what the exact nature of a man's activity shall be. In 1200 the man who wished to distinguish himself became a crusader, in 1500 a bandit, in 1800 an iconoclast, and in 1930 he will become an engineer."

It is a conception that led Thomas Sugrue a few months ago to end a thought-provoking interview with the distinguished actor Burgess Meredith, entitled "Farewell to Youth," as follows:

> (*The car is speeding along at 50 miles an hour rapidly approaching the George Washington Bridge, the lights of which hang in the darkness like a necklace at the throat of night.*)
>
> *Sugrue:* Well, anyhow, it's so long to our youth, I guess, until our own sons grow up and get tangled in the web.
>
> *Meredith:* Maybe we'll have something for them by then. (*He points to the bridge ahead of them.*) When I see that I take faith. It's the most graceful, beautiful thing I've ever seen. The engineers are the artists of today. No poet could create anything like that.
>
> *Sugrue:* They say that a country first records its artistic personality in its architecture. . . . Greece did, Egypt did, Rome did.
>
> *Meredith:* Maybe it's a sign. . . . Let's follow it, since our youth is over, and see where it leads.

It is a conception that led Spengler to write: ". . . one figure is even more important than all the energy of enterprising mastermen that make cities to grow out of the ground and alter the picture of the landscape; it is a figure that is apt to be forgotten in this conflict of politics—the engineer, the priest of the machine, the man who knows it. Not merely the importance, but the very existence of industry depends upon the existence of the hundred thousand talented, rigorously schooled brains that command the technique and develop it onward and onward. The quiet engineer it is who is the machine's master and destiny."

And so, as these and may other tributes that might be quoted indicate, the public has come to respect, almost to revere, the engineer as a master technician. And it scarcely needed the general strike in Great Britain a few years ago, with its threatened tie-up of transportation, or the recent and fortunately very brief power-plant strike in Flint, Michigan, to bring home to the public mind how completely modern civilization is dependent on the technical achievements of engineers both in the invention and development of, and in the continuous, dependable operation of, our modern facilities of sanitation, of communication, of transportation, of fabrication, and especially of provision of the necessary raw materials, both vegetable and mineral.

THE ENGINEER IS MUCH MORE THAN A MASTER TECHNICIAN

But it is this same conception of the engineer as *merely* a master-technician that led Walter Lippmann to say just recently:

> ". . . the conception of government as a problem in engineering is a false and misleading conception . . . the image of the engineer is not a true image of a statesman, . . . society cannot be planned and engineered as if it were a building, a machine, or a ship. The reason why the engineering image is a bad image in politics, a bad working model for political thought, a bad pattern to have in mind when dealing with political issues, is a very simple one. The engineer deals with inanimate materials. The statesman deals with the behavior of persons."

While I am inclined to agree with Mr. Lippmann's belief that engineers are not as likely as are the members of some other professions to be useful in the politics of the near future, it is

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An address delivered at the National Metal Congress, Atlantic City, N. J., Oct. 19, 1937.

not at all for the reason that he adduces. His reason is founded on the prevailing conception of the engineer as nothing but a master technician; but he has long since become much more than that.

Someone has defined engineering as the art of mobilizing materials, money, and men for the realization of projects beneficial to mankind. It is a statement worth examining in some detail. It contemplates activity in three fields, not one. The engineer does have to deal, as Mr. Lippmann suggests, with inanimate materials. But he also has to deal with the economic aspects of every problem he tackles. And always he has to deal with men.

It is something like forty years since President Humphreys introduced into the Stevens curriculum a series of lectures on what he called the economics of engineering, and by this innovation in engineering education started a trend that has spread to every engineering school in the country. And it is also something like forty years since Frederick Winslow Taylor and Henry L. Gantt, both Stevens graduates, laid the foundations of what their disciples liked to call scientific management. Much water has gone over the dam since the publication of Taylor's paper on "Shop Management," and much of the detail to which his loyal disciples wished to adhere so rigidly has been modified in current practice. But the fact remains that, directly or indirectly, Taylor and Gantt and the Gilbreths and a host of others, largely engineers both by formal training and by experience and outlook, have revolutionized the management of industry throughout two continents.

This field of management has long since become one of great importance both in the curricula of engineering schools and in the activities of their graduates. Included in it are such matters as plant design and plant layout which are often determined largely by questions of internal transportation. Included also is the important matter of the utilization factor of machines and other equipment, the choice between highly specialized but inflexible machines and such as will give the production manager more elasticity to work with. Included also are questions of bottlenecks in existing plants. Then there are the whole fields of production planning and of production control. Modern selling also requires, in many cases, the rendering of an engineering service to prospective customers that was unthought of forty years ago. Furthermore, the servicing of a product after it has been sold, so that the customer gets his full money's worth, often requires engineering skill of a very high order. Obviously, a young man who is preparing himself for a career in any branch of management must greatly supplement the purely technical training that the public thinks of as the sum total of an engineering curriculum. He must learn far more, both in college and through experience, than merely how to deal with inanimate objects.

Especially is this true in the crucial field of employer-employee relations where the problems range all the way from the purely utilitarian one of getting more production per man-hour expended to the highly idealistic, but, to my way of thinking, vastly more important one of so managing industry that each employee gets the maximum of durable personal satisfaction out of that very large part of his life that he spends on the job. Much has been done in the last fifty years in this field of labor relations, a surprisingly large part of it by men with engineering training.

And yet when one considers what could and should be done, one realizes that the surface has barely been scratched. We have known for years that there are many different types of workers, each best fitted for a different type of work, and each sure to be both inefficient and unhappy in the wrong type of work. The adjustment of workers to the work has been going on mostly by a sort of trial-and-error method with, on the whole, surprisingly good results, but nevertheless at considerable cost both to employers and to employees, and with by no means a negligible number of misfits that never get straightened out. A group of industrial psychologists, many of them with engineering backgrounds, have been attacking this problem lately, and have made significant progress. But even yet, as far as I am aware, nobody knows how to make so simple and fundamental a discrimination as that between workers who will be happy and efficient on an assembly line and those who will be far happier and more efficient on such a job as packing paper flowers in cartons, except by the trial-and-error method. In the next few years we shall see much progress toward the solution of the all-important problem of fitting each worker to his work.

Equally important are the problems of employee and foreman training to which so much attention has been given by management associations in recent years. There is also the whole field of the "one best way" to do a job, of motion study, of fatigue study, of fitting the work to the worker, as distinguished from fitting the worker to the work. Here, too, lie whole vistas of possibility in the direction of making the worker both more efficient and better satisfied with life. I believe that it is in this field of employer-employee relations that the most significant and far-reaching progress in business and industry is going to be made in the next twenty-five years, that engineering trained men will be responsible for a considerable part of this progress, and that we of the engineering colleges must pay even more attention than ever before, both to giving all of our students some background in this field, and to developing it through the training of specialists and through research. All this, of course, means a considerable step beyond the purely technical training that the general public, including Mr. Lippmann, still thinks of as constituting our whole curriculum.

ADMINISTRATION THE FIELD FOR FUTURE ENGINEERS

But even this is not the full measure of the job that engineers and schools of engineering have ahead of them. Some five years ago James D. Mooney, president of the General Motors Export Corporation, presented before a management session of The American Society of Mechanical Engineers an extremely significant paper in which he suggested a sharp differentiation in the use of the words "management" and "administration." With his permission I beg leave to quote to you some of his sentences.

"Management," he says, "is concerned with the sphere of action, with the day-to-day decisions related to carrying out the (general) policies (of an industrial enterprise), with securing the best results for the industrial effort under such conditions as impose themselves upon it from month to month, with making a monthly profit, or, under extremely adverse conditions, stopping the loss at a minimum, and finally with just decisions of *the day's* problems relating to the equities of clients, stockholders, and employees."

As we saw a moment ago this is an important field of activity, a field for which, if we may judge by past history and present trends, engineering-trained men seem to be rather unusually well-equipped, a field which engineers are more and more making their own, a field in which there is need for much to be done both in the day-by-day conduct of industry, and in the blazing of new trails, the forging of new tools, the establishment of new procedures, and the formulation of new ideals.

But for all its value, management is a very different thing from the still more important function that Mr. Mooney calls "administration."

"Administration," he says, "is concerned with the sphere of policy, with the general problem of fitting the particular industrial effort to its economic, political, and social environment, . . . with the balancing of the *general* equities among the clients, the stockholders, and the employees."

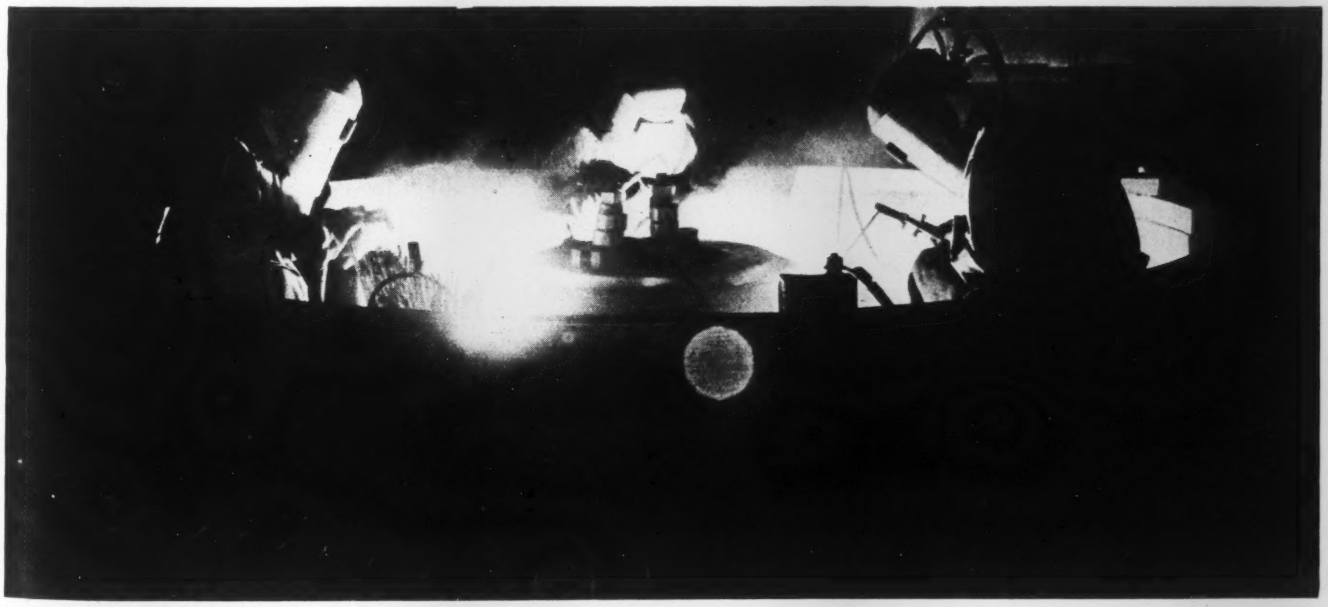
"In short," to quote again, "administration is concerned with the strategy of the industrial operation; management, with the tactics. Administration comprises the problems that lie on the desk of the president of the company, management includes the problems that lie on the desk of the general manager . . . . It has been made plain to us by the depression that we are good production managers, but that we have not succeeded too well as administrators of industry."

Here lies, as I believe, the most significant of all of today's challenges to the engineer and to the school of engineering. It is to industrial administrators with vision and understanding, sensitive to the current major trends, economic, political, and social alike, and yet steadfast in their faith in the ultimate dependability of human nature and in the ultimate value of enlightened individual initiative, rather than to politicians, that we must look for gradually evolved solutions of the major problems of today and tomorrow.

Mr. Mooney pointed unerringly to the root of most of them when he said that the administrator is concerned with "balancing the *general* equities among clients, stockholders and employees." These nine words cover a tremendous range of problems. Shall the national government attempt to "share the wealth" and "soak the rich"? What about the hundreds of thousands who have joined the C.I.O. and started fighting for their share of the national production? What about these "yardstick" power plants launched ostensibly to protect the client interests of all of us in our consumer capacities? Must consumption be subsidized à la Dr. Townsend or the somewhat more intelligent Major Douglas? Is a profit-economy based on a vast use of credit inherently unworkable in the long run? Are there not other motivations active in industry today paralleling and often surpassing in potency the profit-motive so much discussed by theoretical economists? All these, and a host of other kegs of dynamite, lie buried beneath the simple little statement that industrial administrators are concerned with balancing the general equities among clients, stockholders, and employees. And the industrial administrators of today and tomorrow will have to handle these kegs of dynamite sanely, wisely, and with real understanding of the emotions, ideas, and ideals involved, or the politicians will explode them under our feet, one by one, until the whole face of civilization is completely changed. The major national problem of today is the continuing development of a sufficient supply of potential industrial administrators cast in the large mold that Mr. Mooney envisages.

I like to think that just as the engineer-technicians of a century ago have developed into engineer-managers of unsurpassed skill today, so they in turn may develop into the engineer-administrators of tomorrow, able, as Mr. Mooney puts it, "to philosophize about the general scheme of things" and to feel "the changes of the industrial tides" to which from time to time they have to adjust each his own industrial activity. Here is the real place of the engineer in modern life.

Here, too, is today's challenge to the schools of engineering. Not that we can easily train young men to be industrial administrators in this new sense. Heaven forbid! We had enough of that sort of thing in the recent wave of attempting to train college boys to be executives. But we can recognize the utmost heights of the paths that lie ahead for the very best of our students, and the lesser but still significant heights that lie ahead of that majority of our students who are even now regularly going into business and industry as distinguished from the more technical careers of the profession of engineering. And having recognized these possibilities we can at least do our utmost to give these young men something of the background and something of the understanding that will inspire them to grow in wisdom as well as in technical skill throughout their lives so as to be ready, each for his own chance when it comes. If we can do that, we shall have made a vital contribution to the maintenance of civilization.



WELDING LOW-SPEED MARINE REDUCTION GEAR IN GENERAL ELECTRIC WORKS AT LYNN, MASS.

POSSIBILITIES OF METAL SPRAYING

By JAMES W. GIBBONS

AMERICAN SUGAR REFINING COMPANY, BROOKLYN, N. Y.

SINCE THE time years ago when Dr. Schoop saw the apparent cohesive qualities of lead bullets impinged on each other on a brick wall used by his children in their rifle practice, the idea of coating metals was born and has constantly gone forward by experiments, failures, and successes until now in 1937 we have guns instead of pistols. Spraying metal is not new as the previous paragraph shows, but not until the present has it taken such enormous strides as in the last 3 or 4 years. The work has been done in a more or less haphazard hit-or-miss fashion by all who have tried this method of making metals cohesive and dense enough to stand the strains of our present skeptical workaday world.

The writer has been priviledged to go into these methods in a practical manner, trying out different methods and different applications in an industrial plant where room was available for all classes of this work from the simple coating of sheet metals to the more elaborate building-up of worn parts, fireproofing of wood, and ornamental work of a much different character than that which is generally given to the ordinary sprayer of metals.

TECHNICAL SIDE NOT FORMIDABLE

The technical side of this process does not loom up formidably, it is mostly a matter of good judgment and sound practical common sense. Preparation of the surface to be coated plus selection of proper metal for the particular job is the most essential part of the work. Extreme care must be taken to keep the work clean after sandblasting and while in the process of coating. Finger marks or rubbing the hand on a surface while spraying is one of the worst foes to a good finished product. These marks or in fact any grease spot, no matter how slight, should be cleaned off with ether before proceeding with the job.

Not much has been written on the subject. "Metal Spraying," by T. H. Turner and N. F. Budgen which was published in 1926 is probably the only authoritative book in the United States. A search for books on this subject in New York City revealed only two. One is in the Pratt Institute Library in Brooklyn, and the other, which is the Turner and Budgen work, is in the Engineering Societies Library. Many pamphlets and short articles describe the process, but no really constructive work has been done by any author.

An article in *The Iron Age* in April, 1936, is well-written and highly educational but does not make an appeal to the gun operator. What he needs is a definite method of procedure laid down for him in a most positive manner. Gun operators usually are men recruited from the ranks and trained to operate under supervision. Occasionally one finds a man sufficiently interested to delve into "the reason why," but as a general rule the operators only know what is the regular procedure and work accordingly. They are not concerned whether the particles are streamlined, round or flat, in passing from the gun to the object to be coated. As long as the flame looks right and the metal is being deposited, they are satisfied. Where a large quantity of metal had to be deposited at a high melting point, the surface would look to be good, but under the top layer would be some burned metal, showing that the operator had either held his gun too close or had played the stream too long in one spot and to shield himself had flashed a coat of metal on top of the burnt portion so as to appear from casual observation, the job was as it should be. Practices of this sort are hard to uncover, unless the observer can see some visible evidence of burnt metal, but will show up sooner or later in what will be said to be a poor job. So much work of this kind has been done in the past, that metal spraying was looked upon with disfavor because of poor or unskilled labor, which stopped its progress until recent years. Improper surfacing of metal to be sprayed had 75 per cent of the poor work to its credit, while the improper metals and the wrong application had the honor of the other 25 per cent. Now the art of metal spraying is beginning to come to the front in the way it should and give the credit of its discovery to those who first brought it to light.

SAVINGS

The savings that this process creates can hardly be measured in dollars and cents alone, although that is the dominating factor of the present day. To the engineer maintaining a plant of any considerable size his natural enemies, corrosion and erosion, can be stopped and surfaces hitherto rusted and worn can be kept up to their original appearance by this method and in most cases be made better if properly applied. Many pages could be filled with successful applications of this method on piston rods, crankshafts, centrifugal-pump casings, impeller shafts, and sheet-metal surfaces in all the channels of trade, not only for protection of the apparatus but also of the commodity manufactured or produced by keeping it clean and pure. Eliminating all black specks formed by corrosion and erosion and stopping waste production of the material manufactured or refined is in itself something to be considered. Today hundreds of manufacturing establishments with problems like these are at their wits' end to stop waste and destruction of metals used in different processes. Metals that will withstand wear and corrosive action are high in price, where by the application of the metal-spray process a metal that is much cheaper can be used as the base and coated with expensive metal at much less cost.

An editorial in the November, 1935, issue of *Machinery* seems to sum up the possibilities of this great process in a few well-chosen words and one wonders why engineers who know of, or have had experience with, this process do not use it more widely. It does seem astonishing to talk to engineers who have heard of metal spraying but have never investigated its possibilities and resources. Of course, the engineer of a small plant could not possibly get an appropriation for the outfit, but firms who are doing this sort of work would be glad to assist him in his efforts to save his employer some hard cash by a little reclamation work. Piston rods, valve stems, governor spindles and hosts of other equipment parts that give trouble and would cost considerable money to replace can be salvaged and made as good as new, if not better, in some instances. One could go on indefinitely writing on this subject, as it is one that cannot be worn out readily, but if our engineer readers would only take heed and make a few inquiries, they certainly would learn something that would be greatly to their advantage.

Grinding of Sintered CARBIDE-TIPPED TOOLS

By MALCOLM F. JUDKINS

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GRINDING was one of the most serious early obstacles and retains its position of importance to best results with sintered carbide-tipped tools today. Special wheels of new and unusual characteristics had to be developed because emery wheels proved ineffectual in grinding the hard carbides as they glazed and generated excessive heat without removing stock. Suitable machines had to be designed since the old type of grinder consisting of a plain wheel on each end of a motor-armature shaft that had plenty of end play, with a pan full of not-too-clean water in which to dip the tool when it became too hot to hold, was found wanting. Personnel had to be trained. Experienced cutter-grinder hands were prejudiced and overrated the difficulties of grinding fluted hard-metal tools. Lack of confidence on the part of small-tool men that good tools tipped with sintered carbide could be made and serviced under practical toolroom conditions was largely responsible for the lengthy trial period through which fluted tipped tools slowly passed. Procedures needed to be established. Instructions and precautions had to be summarized. New problems never encountered in grinding tool-steel tools arose in connection with jigs, fixtures, and other work locating and holding means. Lastly, the scope of sintered-carbide tool application had to be defined.

The objects of grinding are rapid, economical production or restoration of keen cutting edges and the smoothest possible tool-chip work-contact surfaces. The ideal grinding wheel is designed to cause rapid wear; its surface is sharp and rough. The ideal tool is designed to cut with minimum wear, which is another way of saying maximum durability or tool life. It must be sharp and smooth.

Manufacture of tools including grinding from the rough was originally the sole concern of the sintered-carbide supplier; now it is the problem of the user as well. Many large users purchase unground tools, which are called milled and brazed, or supply shanks milled ready to receive the tips that the supplier brazes in place. Others buy raw tips and fabricate the entire tools themselves. For this latter method a simple and inexpensive hydrogen-atmosphere electrically heated brazing furnace, Fig. 1, has been developed.

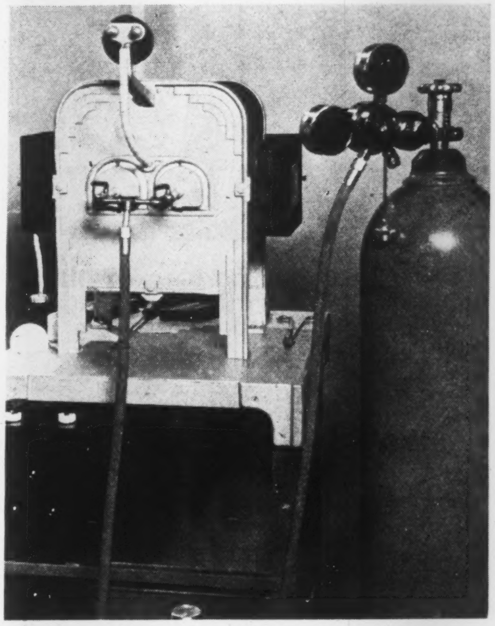

FIG. 1 HYDROGEN-ATMOSPHERE ELECTRICALLY HEATED FURNACE FOR BRAZING CARBIDE TIPS ON SHANKS

REQUIREMENTS OF ROUGH GRINDING

Requirements of proper rough-grinding practice are rapid stocking without damaging the cutting tips. Coarse-grit, open-structure, soft-bond, cool, and free-cutting wheels are needed. Diamond wheels are used on surface and cutter grinders but rarely for roughing shank tools on an offhand grinder. A true, steady wheel spindle of substantial size running at the proper speed in large snug bearings is needed. Effective wheel dressing to maintain truth and avoid bumping is required, and dulled abrasive grains which are not thrown out of the wheel by natural wear must be removed by dressing. A flood of coolant must be supplied at the surface being ground. The tool must be correctly presented to the wheel. Either line or minimum-surface contact must be realized. The former can be attained by moving the tool tangentially with respect to the periphery of a plain wheel while the latter may be provided by moving the tool by hand across the wheel surface while it is supported by a protractor table rest while rocking it from side to side and from end to end and by grinding compound clearances. This latter means relieving the steel shank beneath the tip at an angle slightly in excess of the clearance angle that is ground on the tip itself. Relief may be ground on a wheel best suited to grinding tool steel and the sintered carbide only is then ground on a silicon-carbide or diamond wheel.

Much can be done to minimize and simplify grinding by careful design and planning before brazing. Fluted tools should be turned, milled, bored, and recessed close to finish size, allowing only for finish and possible warpage or distortion due to brazing of the tips. Spot-facing tools and, in general, all piloted tools should be brazed in such fashion as to prevent the tips from protruding into the pilot-shank recess which would necessitate difficult as well as unnecessary grinding and lapping. This is most easily done when the pilot diameter is greater than that of the pilot shank. Reamer shanks can be turned slightly under cutting diameters on the cutting end. The tips then protrude slightly and only the carbide need be circle-ground and relieved. Holes in hollow mill shanks can be bored slightly oversize for the same reason and

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Contributed by the Special Research Committee on Cutting of Metals for presentation at the Annual meeting, New York, N. Y., Dec. 6–10, 1937, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

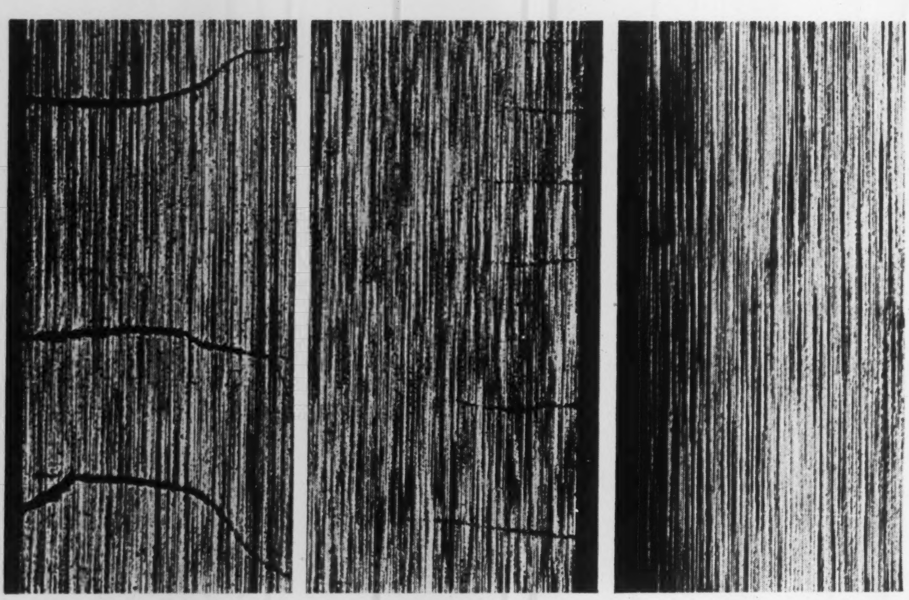

FIG. 2 CHECKS RESULTING FROM ALLOWING THE GRINDING WHEEL TO DWELL IN ONE PLACE

with the same resultant saving in grinding expenditure. This overhang of the tips beyond the supporting shanks rarely need be more than from $^{1}/_{64}$ to $^{1}/_{32}$ in. The light service to which these tools are subjected makes the unsupported portion of the tip negligible from the breakage standpoint.

Fluting should consider wheel clearance and accessibility for grinding and resharpening as well as flute strength and chip space. Tips should be closely and carefully fitted in their recesses and located and shaped so as to provide ease in resharpening.

Type of relief should be selected after weighing the requirements for performance and ease of grinding. Eccentric relief is frequently desirable especially for formed cutters; but because of the greater difficulty in grinding, flat relief is widely used in conjunction with small concentric lands that are left round from the circle-grinding operation but should preferably be carefully ring-lapped to an approach to a gage surface to minimize wear and produce smooth work surfaces that are free from scratches and toolmarks.

FINISH-GRINDING COMPRISES TWO CLASSES

Time expended upon finish-grinding is largely dependent upon the care exercised in rough grinding. If the roughing has been carefully done, the main object of finishing is to find size and refine the sharpness of the edge and the smoothness of the tool-chip work-contact surfaces. Finishing can be divided into offhand and machine grinding. Shank tools and tool bits for turning, boring, facing, chamfering, and the like are usually finished freehand, being moved across the surface of a ring or cup wheel while resting on a protractor table. Diamond wheels are widely used for this purpose. When such tools are to be ground to a finish without diamond lapping, grinding marks should always be parallel to the direction of chip flow. This will minimize the resistance offered to the sliding of the chip across the tool face and not only improves the machined finish through reduction of the size of the built-up edge but also inhibits abrasive wear as well, because friction is limited and controlled.

Lapping is especially important on the face, lands, and flanks directly below cutting edges. It is beneficial on all tools regardless of the type of service for which they are intended. An initially smooth tool-work surface will definitely postpone wear even in the case of roughing tools.

Machine grinding can be further resolved into surface and cutter grinding. The former is undertaken to produce nearly flat, smooth surfaces and cannot take the place of lapping even when diamond wheels are used, since grinding produces scratches. To cut cool and free, the size of abrasive particles and their spacing in the wheel surface must be of such magnitude as to function as milling-cutter teeth. If the grit and spacing are reduced beyond certain critical values, burning of the sintered-carbide tips occurs even under a coolant if rates of stock removal that exceed lapping proportions are attempted. Fine-grit wheels lacking adequate chip space tend to load and a formed wheel will nearly always leave scratches. A generating cut or hand-lapping operation is necessary to attain a really smooth surface on forming tools. To attain the type of surface required for the lands of piston-grooving tools, lapping is essential. Only by lapping away the crests of the finish-grinding scratches and approaching a flat surface at the bottom of these valleys can rapid wear and premature loss of size be avoided. These remarks apply with even greater emphasis to the refinement of the concentric lands of reamers.

The cutter grinder is frequently used for form grinding and

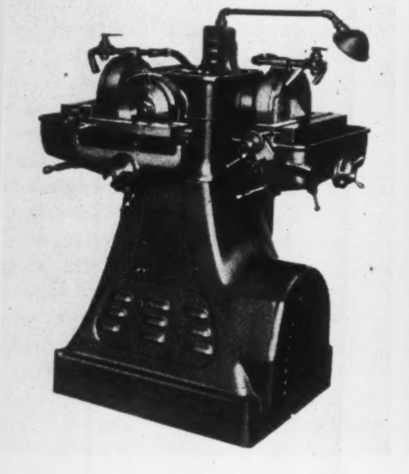

FIG. 3 GRINDING MACHINE FOR RAPIDLY RESHARPENING A LIMITED VARIETY OF TOOL-BIT SIZES AND TOOL-BIT SHAPES

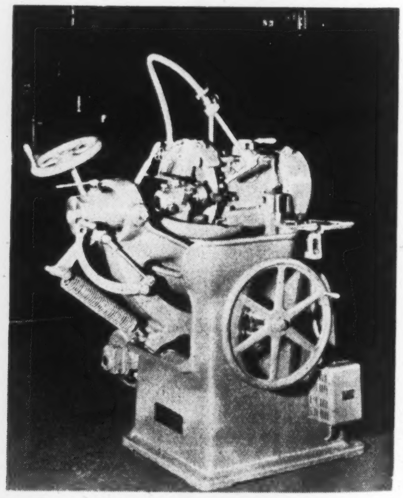

FIG. 4 MACHINE FOR ROUGH ANGLE GRINDING IN WHICH LINE RATHER THAN SURFACE WHEEL-WORK CONTACT IS PROVIDED

relieving in lieu of the hand-fed surface grinder for delicate tool bits in addition to its more common usage in finishing fluted tools and inserted-blade cutters such as face mills and for accurately sizing lands as on piston-grooving tools. Of all shop tools, this machine is least adapted to wet grinding.

USES OF THE CUTTER GRINDER

Due to its sensitivity and relative fragility, the cutter grinder should never be used for stocking. Its reliability for producing accurate work can only be preserved by assigning to it work that has either been carefully roughed close to size or designed to require a minimum of finish-grinding. Because cutter grinding alone of all the other types must be done dry, it must be done slowly with provision for rapid movement of the work past the grinding wheel. The wheel must not be permitted to dwell at any point on the work. Grinding checks will almost surely result if this precaution is ignored (see Fig. 2). Avoid grinding steel and carbide together with diamond cup wheels as the large work-wheel contact will frequently generate enough heat to crack the tip. Maximum rate of stock removal, minimum wheel wear, freedom from grinding stresses and cracks or checks, and increase of chuck load have been realized in surface grinding by using table speeds of from 75 to 125 fpm. For best results in machine or hand grinding, speed of the work with respect to the wheel must approach the maximum. Duration of wheel-work contact per pass must approach the minimum. As wheel-work speed increases, use of harder wheels is made possible.

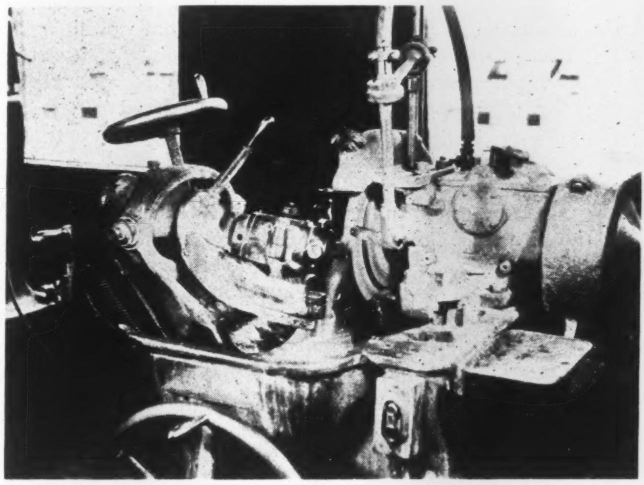

FIG. 5 RAPID REMOVAL OF STOCK WITHOUT DAMAGE TO THE CARBIDE TIP CHARACTERIZES THIS MACHINE

(A heavy stream of water is thrown on the tool as it is carried along a tangent to the wheel which has an oscillating motion at right angles to its direction of rotation.)

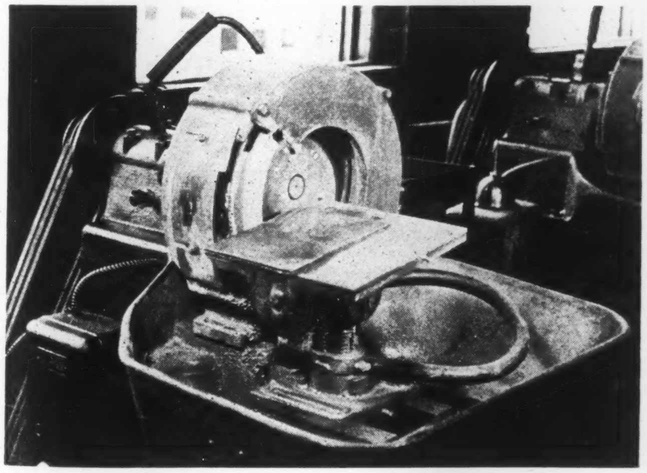

FIG. 6 MACHINE FOR SEMIFINISH ANGLE GRINDING

(The desired clearance or rake angle is obtained by setting the protractor table rest and the tool is moved across the surface of the wheel by hand.)

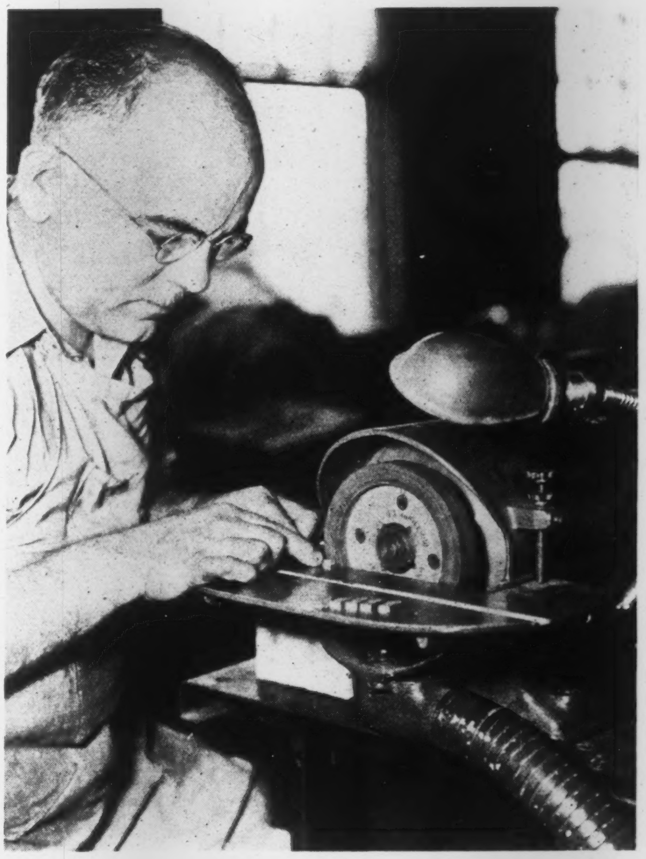

FIG. 7 GRINDING SMALL TOOL BITS

Cutter grinders even when equipped with diamond wheels cannot replace lapping. Grinding is essentially a process in which the surface layers of a material are removed by the cutting and attrition of abrasive particles embedded in a supporting matrix. Lapping is essentially a process of surface refinement unattended by removal of appreciable material. Finding size and producing the class of surface finishes required for plug and ring gages as well as burnishing tools can be accomplished solely by lapping.

VALUE OF CORRECT PROCEDURE

Eight years of grinding carbide tools have taught suppliers the value of correct procedures. Many users have adopted effective grinding methods, but, through lack of authoritative information, many users are following grinding practices that are not only costly and ineffectual but also prejudice them against carbide tools.

Proper grinding methods permit use of carbide tools with no increase in cost of maintenance over previous cutting materials. Certain precautions are vital to successful grinding of carbide tools regardless of the size of the establishment using

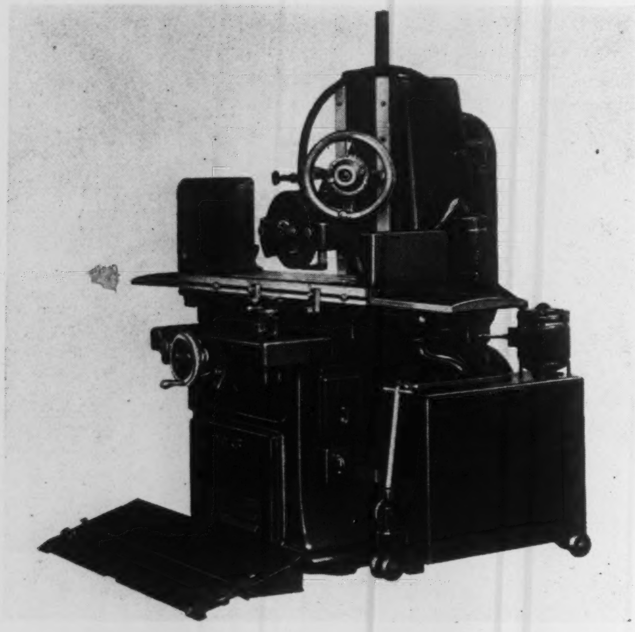

FIG. 8 MACHINE FOR SURFACE GRINDING CARBIDE-TIPPED TOOLS

(Massive rigid construction characterizes this machine. A large spindle closely coupled to the column absorbs heavy wheel-work reactions without deflection. Infinitely variable rate of table traverse is provided by hydraulic feed.

them. These instructions are worthy of emphasis and therefore of repeating:

(0) Always grind on the proper wheel; rough on a plain wheel and finish on a cup or ring wheel.

(1) Always grind toward the cutting-edge shank support.

(2) Move the tool rapidly across the grinding surface using a light pressure.

(3) Grind wet, if possible; using plenty of water; dry grinding must be slow grinding; avoid heating; never periodically dip the tool in water.

(4) Dress the grinding wheel as often as necessary to keep it true and free cutting; loaded or glazed wheels will not cut properly; crown cup and ring wheels to limit contact area.

(5) Grind to measured clearance and rake angles; avoid guessing by resting tool on a protractor table or tool rest.

(6) Use a heavy grinder with a true, steady spindle carried in substantial bearings with adequate driving power to prevent slowing down; wheel speed should be between 5000 and 6000 surface fpm.

(7) Keep wheel-work contact area at the minimum; grind from 5–10-deg relief on the steel shank under the carbide tip.

(8) Resharpen the tool before it begins to "labor."

(9) Finish-grind flat clearances on the face of a cup or ring wheel; avoid overhanging lips produced by the curvature of a plain wheel.

(10) Lap all tool-work surfaces with care.

Much could be said in defense of these simple rules. If they are carefully followed, results will speak for themselves.

WIDE RANGE OF MACHINES AND WHEELS AVAILABLE

Purchasers of grinding equipment today can choose machines and wheels to fit their own special requirements from a wide selection of readily available types and qualities at prices in keeping with the class of service and budget or size of appropriation. The small shop does not wish to pay a premium in the form of a large investment for special grinders and costly wheels to enable it to use carbide tools. Existing machines can be equipped with special wheels such as 3760/1+7 12, or 60*RWGG* and provision made for wet grinding by installing a collecting basin, means for filtering or straining the coolant to separate it from the grit, and a coolant pump and reservoir delivering a flood of coolant through a wide flat nozzle at the grinding zone or one of the machines priced under $350 can be purchased. A protractor table can be contrived at small expense. In either case, the machine should be set apart and plainly labeled as intended for grinding carbide tools only.

Production shops can be divided into two classes, (*a*) those using a large quantity of a limited number of designs and (*b*) those whose requirements embrace a wide range of tool styles. For the former, single-purpose machines are indicated. Such machines can be had with attachments and fixtures that are especially adapted for rapidly resharpening a limited variety of tool-bit sizes and shapes. This type is illustrated in Fig. 3. Roughing, finishing, and lapping wheels are provided on this unit. On account of slow speeds, special soft wheels such as 3760/1-*H*7, or 60*SWHG* are recommended for use with this equipment. This machine is also available with two grinding wheels and without the lapping disk.

The large user needs as wide a variety of machines as the supplier, particularly in view of the growing trend toward buying raw tips and manufacturing tools complete. Freehand roughing is best accomplished on a machine using 3760-*J*+7 or 60*NWCG* wheel. Rough angle grinding is quickly and eco-

FIG. 9 DIAMOND-WHEEL GRINDER FOR FINISH-GRINDING

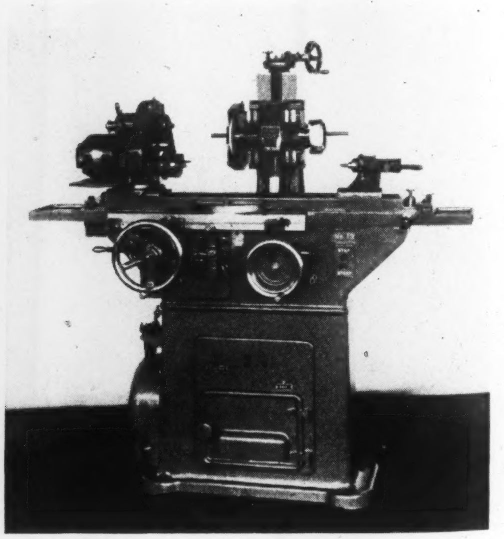

FIG. 10 UNIVERSAL AND TOOL GRINDER WELL ADAPTED TO CIRCULAR WORK

nomically done on the type of machine shown in Fig. 4 which, because of the manner in which the tool is presented to the wheel, provides line rather than surface contact. Fig. 5 shows a machine that will remove stock rapidly with no damage to the carbide tip. A heavy stream of water is thrown directly on the tool as it is carried along a tangent to the periphery of the wheel which has an oscillating motion at right angles to its direction of rotation. Wheels 3780-*J*+7, or 80*RWGG* will give uniformly good results.

Semifinish angle grinding can be efficiently done on the type of machine that is illustrated in Fig. 6. The protractor table rest is set to the desired clearance or rake angle and the tool is moved across the surface of the cup or ring wheel by hand. This machine affords all the advantages of hand grinding, giving the operator the opportunity of delicately regulating pressure, and yet the rapidity and ease with which rakes, clearances, and radii can be produced are remarkable. Wheels 37100-*I*+9 or 120*RWGG* give excellent results. Ring wheels are cemented into steel adapter plates with ordinary sulphur for use on this grinder.

The foregoing group of machines is more adapted to carbide-tool suppliers and large users than to the average shop. For the latter, several moderate-priced grinders are available. For example, a grinder may be had for less than $350 and a table or bench model without the wet grinding feature for less than $125. The machine shown in Fig. 7 should only be used for small tool bits. Heavier machines should be used for larger solid-shank tools.

DIAMOND WHEELS BEST SUITED FOR CARBIDE-TIPPED TOOLS

Unquestionably, more arbor pressure is involved in surface grinding carbide-tipped tools than is encountered on other work. This requirement compels the use of a massive, rigid, and powerful unit. A light machine will grind the steel shank below the level of the carbide tip due to "spring-back." Hydraulic feed with its accompanying infinitely variable rate of table traverse is indicated. Fig. 8 shows a machine that meets the requirements. Wheels 3760-*K*7 and 60*NG*$_2$*G* are used with a table speed of 125 fpm. For slower travel, softer wheels, such as 3760I-*H*9 or 60*SWHG*, must be used. When grinding pure carbide or tools on which the carbide comprises a major part of the surface to be ground, diamond wheels are used on this equipment with excellent results. Stock removal matches down feed as measured by the wheel-head dial and the necessity of taking the work from the magnetic chuck for repeated size checking, which is unavoidable with silicon-carbide wheels, is unnecessary when using a diamond wheel.

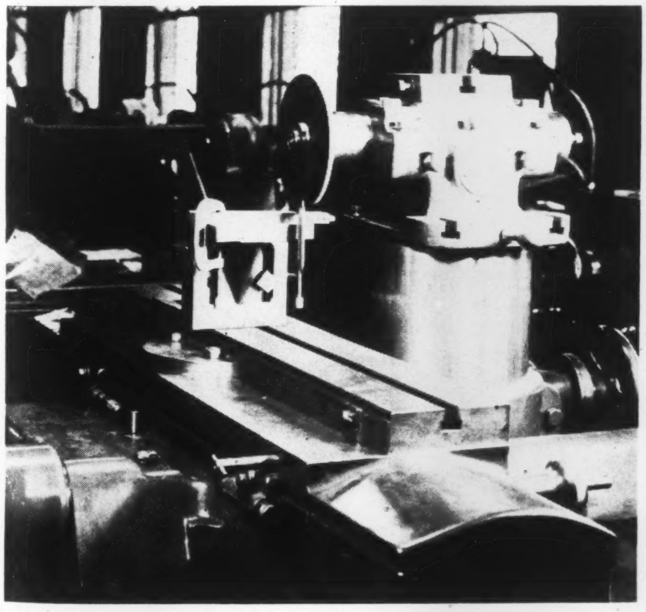

FIG. 11 CLOSE-UP OF THE HEAD ON A DIAMOND-WHEEL CUTTER GRINDER

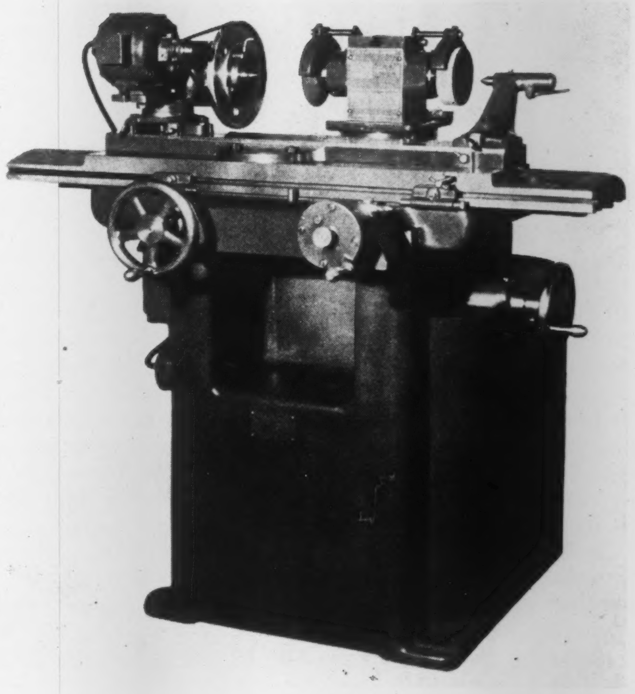

FIG. 12 TOOL AND CUTTER GRINDER WELL ADAPTED TO GRINDING FLAT FORMING TOOLS AND RESHARPENING FACE MILLS

Finish-grinding is best accomplished on a diamond-wheel grinder of this type, Fig. 9. An adequate supply of water is provided to permit rapid grinding with no appreciable rise in tool temperature. The machine has a generous sized spindle running in excellent bearings. Multiple V-belts effectively prevent driving tremors from being communicated to the grinding wheels. The protractor tables which facilitate proper rake and clearance angles are strong, substantial, and easily adjusted. Diamond wheels of 100 grit quickly produce keen edges and smooth surfaces and are used exclusively. Finer grits do not cut readily but tend to burn. For tools requiring ultrasmooth surfaces, lapping with diamond dust and olive oil on a cast-iron disk is recommended.

The diamond wheel reaches its greatest usefulness on the cutter grinder, Figs. 10 and 11. Margin of hardness between diamond and carbide is sufficient to permit of rapid, easy, grinding without wheel-work reactions such as are necessary to cause stock removal with silicon-carbide wheels. This is especially fortunate in view of the inherent fragility of the cutter grinder. With angle plates and universal vises, a variety of form tools can be rapidly and accurately ground on this type of machine. The diamond wheel affords a means of grinding accurate serrating tools economically. Small fluted tools and cutters can be ground from the solid. Reamers under $^{3}/_{16}$-in. diameter and thread-milling cutters have been made in this way with appreciable savings compared to tools with individually tipped flutes. A new collet-type rapid-acting chuck has recently been developed for this grinder for use on small work not requiring grinding on centers.

MONTHLY EARNINGS *of* ENGINEERS

Seventh Series of Results of the Survey of the Engineering Profession Conducted by the U. S. Bureau of Labor Statistics

SIX SUMMARY reports based on analyses made by the United States Bureau of Labor Statistics on returns from 52,589 engineers have already appeared.[1] The present article is concerned with the monthly rate of compensation received by engineers solely for engineering services in which they were engaged at the end of 1929, 1932, and 1934 with which the sixth report[2] deals. From the introductory paragraphs of this report, in which the results are summarized, the following paragraphs are quoted. The information on which this article is based was furnished the Bureau in its survey of the engineering profession undertaken in May, 1935, at the request of American Engineering Council.

In 1929, the range in monthly engineering earnings of professional engineers was great. Some 79 engineers reported earnings of less than $60 per month, while 168 earned more than $1880 per month. The median monthly earnings of the 28,511 reporting engineers was $289. One quarter earned more than $415, while only 10 per cent had earnings greater than $609 per month.

Between 1929 and 1934, progressive declines occurred in monthly engineering earnings. While the sharpest absolute decreases occurred at the higher levels of earnings, the greatest percentage decreases took place at the lower earnings levels. Almost two thirds of the decreases occurred between 1929 and 1932.

Comparison of earnings by professional class, without regard to age and consequent effect of varying age distributions, shows that in 1929 the upper 20 per cent of mining and metallurgical engineers who were highest at this level reported earnings of not less than $792 per month as against $515 for civil engineers who were lowest at this level. Second in order came chemical and ceramic engineers, followed by mechanical and industrial, and electrical engineers. For the upper 25 per cent of the reporting engineers, the order of the professional classes was the same, monthly engineering earnings ranging from not less than $372 for civil engineers to not less than $503 per month for mining and metallurgical engineers. At the middle and lower earnings levels, differences in earning capacities of the five professional classes were less marked, although, in each instance, mining and metallurgical engineers and electrical engineers occupied the upper and lower extremes, respectively. In 1932 and 1934, the order of the professional classes at the two higher-earnings levels was essentially the same as that noted for 1929. At the three lower-earnings levels, shifts occurred in this order in 1929, and further shifts were noted in 1934.

On an age basis, the 1929 monthly compensation for engineering services of the lowest tenth of reporting engineers was more than twice as high for those in the age group 48 to 55 as for those of 23 years. At the upper 10 per cent earnings level, maximum earnings of $1050 per month were reached in the sixties. Similarly, at the average and at the highest and lowest quarters of earnings, age 60 was the turning point. For men of identical ages in 1929, 1932, and 1934, the data reveal that the greatest impact of the depression, as far as engineering earnings were concerned, fell upon men with from 2 to 5 years' experience.

Although the 1929 data on engineering earnings evidence an advantage in favor of men who have engineering degrees, this advantage was less clearly defined than was the case with earned annual incomes. However, extra years of experience that the "other" engineers had while the graduates were in school permitted of their obtaining higher earnings than graduates only up to a point corresponding to 5 years after graduation. Even at 2 years after graduation, the differentials in earnings between the two groups were slight. Similarly, at 4 years after graduation, at the median level, graduate earnings ranged from $225 for first-degree electrical engineers to $250 per month for first-degree chemical and ceramic engineers. Among "other" engineers, they ranged from $200 for engineers with secondary-school education to $229 per month for mechanical and industrial engineers with incomplete college courses.

With advancing age, a considerable advantage in engineering earnings in favor of the graduates was noted. A distinct variation was also found in the earning capacities among both graduate and "other" engineers. Monthly engineering earnings of graduates continued to increase several years beyond the point of maximum earnings of "other" engineers. The earnings of the latter either remained stable or declined at 30 years after graduation

While graduates who were $23^{1}/_{2}$ in 1929 and $28^{1}/_{2}$ in 1934 reported increased earnings for all kinds of engineering, except mining and metallurgical, no increases were reported by any of the "other" engineers of corresponding ages. For older engineers, however, the decreases apparently affected both graduates and "other" engineers in almost equal measure.

For men of identical years of experience, the earnings received in 1934 by both graduates and "other" engineers were all less than those that were obtained in 1929. Decreases reported by men with 5 years' experience were, in general, greater than those of men with 2 or with from 10 to 37 years' experience.

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[1] "Education of the Engineer," MECHANICAL ENGINEERING, vol. 58, 1936, pp. 505–509. Also: "Educational Qualifications in the Engineering Profession," by Andrew Fraser, Jr., *Monthly Labor Review*, June, 1936, pp. 1528–1542.

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Merchandising Requirements of PRINTED TEXTILES

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FUNDAMENTALLY, the merchandising requirements of any product are those imposed by the consumer. Merchandising organizations endeavor to produce the type of goods they believe consumers will demand at the time their product will be on sale. Thus, the merchandising requirements of printed textiles which must be met by textile-printing establishments consist of a set of continually fluctuating requirements which in the last analysis originate with consumers, with retailers, garment manufacturers, and converters acting as interpreters or forecasters of this consumer demand. The enormous variety which the flexibility of the printing process makes possible here combines with an even greater variation in consumer taste to set up so many diverse and seemingly contradictory trends that any reliable forecast of consumer requirements would appear to be impossible. The increasing awareness of consumers as to how to employ pattern design and color in creating certain ensemble effects or to heighten certain characteristics of one's personality is tending still further to broaden the range of consumer requirements in prints. Thus, we seem to be moving still farther away from the hundred-thousand-yard runs of staple indigo and gray staple calico prints that used to delight the heart of quantity-minded printers in the "good old days."

Determination of consumer style requirements in printed textiles, months in advance of the opening of a season, constitutes a major and unavoidable part of the task of forecasting fashion. As to the details of this process, it is not necessary for us to be concerned here. Forecasting methods of converters may vary all the way from the maintenance of elaborate fashion-reporting services in Paris, Hollywood, and New York and intimate contacts with leading retailers of high-style merchandise on Fifth Avenue, to the simple theft by one converter of the patterns and style ideas of some competitor whose selections have been reasonably successful in the past.

SUBJECTIVE VALUES FORM BASIS OF MERCHANDISING

The one important characteristic of this process of determining consumer requirements on printed textiles, which a person of an engineering type of approach should not overlook, is that the principles and methods which apply in the field of merchandising are of a radically different character from those which apply in fields of activity based upon the exact sciences. Here we are dealing only in part with objective realities, things that can be measured precisely once and for all and that can be subjected to analysis with the aid of formulas and units of measure. Merchandising deals fundamentally with subjective values, values which some consumer will place upon an article at some given time and place. This value may or may not be related to the "intrinsic" value of the article, using that term to mean its cost of production.

Those engaged in merchandising accordingly study human reactions, and their decisions are based upon their observations and forecasts of how people, or a certain group of people whom they have studied, will react. They act as much upon intuition as from reason. Great leaders of fashion, the couturiers of Paris for example, act intuitively. They are artists finding a medium of expression for their artistic sense in fashion. This same approach to fashion from the intuitive rather than the analytical side follows down through the whole fashion world until it finds expression in the demand upon textile printers, who are essentially engineers concerned with keeping machinery in operation, for tremendous and seemingly senseless and unnecessary variations in pattern and color and in unreasonable requests for quick delivery.

Wherever art enters industry we find this same situation existing, with keenness of style perception in the industry keeping pace with or stimulating a similar style consciousness among consumers. Textiles afford a peculiarly personal medium of artistic expression, and particularly printed textiles, because of the almost unlimited technical freedom permitted to the artist. The way in which these technical capabilities are made use of in the various types of printed goods varies widely from one printed-goods market to another.

TABLE 1 PRODUCTION OF PRINTED TEXTILES

Material	Production Lin yd	Production Per cent
Women's wear markets		
Percales	450,000,000	35.0
Sheer wash goods	140,000,000	10.8
Heavier wash goods	80,000,000	6.2
Miscellaneous wash goods	75,000,000	5.8
Rayon and silk dress goods	170,000,000	13.2
Handkerchiefs	14,000,000	1.1
	929,000,000	72.1
Men's wear markets		
Shirting percales	128,000,000	10.0
Broadcloths	70,000,000	5.4
Summer suitings and slackings	40,000,000	3.1
Linings	5,000,000	0.4
Necktie fabrics (silk and rayon)	1,000,000	0.1
	244,000,000	19.0
Household fabric markets		
Cretonnes	60,000,000	4.7
Sateens	4,000,000	0.3
Marquisettes	16,000,000	1.2
Tickings	35,000,000	2.7
	115,000,000	8.9
TOTAL	1,288,000,000	100.0

Fundamentally, there are fifteen divisions of the printed cotton, rayon, and silk-cloth markets. These have been classified as indicated in Table 1 to show both the actual amount of each type of goods which the industry produces and also the

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Contributed by the Textile Division for presentation at the Annual Meeting, New York, N. Y., Dec. 6–10, 1937, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

relative importance of the different types to one another. This information is based on the 1935 Census of Manufactures with certain adjustments.

PRINTS AN IMPORTANT FACTOR IN THREE TEXTILE MARKETS

Printed textiles are thus seen to be factors of importance in three of the four great textile markets; women's wear, men's wear, and household fabrics, excluding only industrial fabrics which are composed chiefly of gray goods. Women's wear is by far the largest, with 72 per cent of the total of printed goods being used in that field, as compared with only about 19 per cent in men's wear and 9 per cent in household fabrics.

Prints account for about one seventh of all cotton goods woven in this country and about 27 per cent of all finished cotton goods. The proportion of prints in silks and rayons is about the same, 19 per cent, although the proportion of plain dyed goods is much higher there than with cottons since there is no group of rayon fabrics that corresponds to bleached cotton goods. Table 2 presents statistics on the production of the different classes of goods in both fields.

TABLE 2 PRODUCTION, BY CLASSES, OF COTTON GOODS AND RAYON AND SILK

	—Cotton goods—		—Rayon and silk—	
	Lin yd	Per cent	Lin yd	Per cent
Prints	1,100,000,000	15.3	170,000,000	18.9
Plain shades	1,200,000,000	16.7	730,000,000	81.1
Bleached	1,700,000,000	23.6	....	....
Gray goods	3,200,000,000	44.4	....	....
TOTAL	7,200,000,000	100.0	900,000,000	100.0

Printed textiles have, in the last 20 years, enjoyed a fairly steady increase in rate of production. No industry statistics are available as to the amount of printed goods turned out during the early postwar years, but it was undoubtedly somewhat smaller than today. Prints have risen in favor with consumers due to improvements in fastness of colors and to the great increase in the range of patterns that are now produced in popular-priced fabrics. As a result, prints have displaced both plain color and white fabrics and also woven style fabrics such as ginghams. Thus, the markets for plain shades and bleached goods have shrunk permanently, both because of this increase in the use of prints and also because of the greatly reduced yardage in both women's underwear and outerwear resulting from new habits and modes of living.

FASHION AND CONSUMER PSYCHOLOGY REGULATE USE OF PRINTS

Aside from this general upward secular trend in printed goods, there have been cyclical swings in the use of prints. No comprehensive statistical studies of these movements have been possible because of deficiencies in our statistics of finishing operations, due to the failure of certain textile finishers to recognize the importance of maintaining adequate industry statistics as to the types of goods which they produce. There have been swings from prints to plain shades in women's dress fabrics as fashion has shifted emphasis from one to the other and vice versa.

There have also been swings away from prints and back again which have reflected changes in consumer psychology independent of fashion cycles in the strict sense of the word. On men's shirtings, we have been able to establish a definite correlation between the sale of prints and changes in consumer purchasing power in the last ten years, with prints selling in increased volume during the years of prosperity and being replaced by plain-shade and white fabrics at the trough of the depression cycle. It seems clear that this has not been so much a matter of price by itself, since prints actually sell at lower prices than the average plain-shade fabric used in shirts but rather a matter of consumer psychology reflecting a return to conservatism in thinking. This particular instance arises primarily from the fact that prints are novelties in the shirt trade, with white and plain shades the staples, whereas in women's dress goods prints are definitely staples despite the wide variety in types of prints that may be employed.

These cyclical fluctuations in prints thus are of two types. One involves a shift in the interest of the trade away from certain types of printed designs or color combinations to others, thereby satisfying in some measure the very human desire of men and women for something different from what they have been seeing. Quite independent of this shift is the ebb and flow in the proportion of prints to the total volume of textiles consumed, as plain shades are substituted for them and vice versa.

We do know, however, that at the center of each printed goods market is a large core of business that remains unaffected year in and year out by changes in style or other factors. How large this core is, no one can judge from the present condition of statistics of the industry's production. It varies from one market to another and is undoubtedly highest in dress percales and similar fabrics. It is smallest in novelty goods, such as men's shirtings which dropped to as low as one quarter of their present volume in the trough of the last depression. In certain types of printed rayon it may not be large, but this field as a whole seems to be taking on essentially the same staple characteristics as printed percales and certain types of cotton wash goods. Likewise, in the drapery field this core of staple business probably represents a fairly large part of the total, since printed cottons are not easily replaceable by plain goods, even though they are susceptible to limited replacement by colored-yarn fabrics.

In short, each of these markets for printed textiles has at the center a core of staple printed business which remains unchanged in size from one year to the next regardless of competition from plain, bleached, or colored-yarn fabrics. It is this part of the market which represents the basic consumer demand for prints. Beyond this center, lies an impermanent market, which is continually expanding and shrinking in size in accordance with shifts in consumer requirements. All types of printed fabrics are represented in this sector, although it is high-style goods that feel the impact of these fluctuations most noticeably. On the whole, the permanent market for printed goods is much larger in proportion to the total market than is commonly recognized and is probably increasing in size slowly from year to year.

PRINTS SERVE THREE CONSUMER REQUIREMENTS

As to the function of prints with respect to consumer requirements, it may be said that prints serve three purposes: To decorate a cloth with a pattern that could not be produced easily in any other way, as for example floral designs; to imitate woven style effects such as stripes and plaids; and to conceal the low construction of a piece of cloth which, if not well covered with a printed pattern, would repel even low-income purchasers.

The largest part of the prints used in women's wear is comprised of patterns requiring flexibility of design and color effects which only printing can give. There is, however, this second group of designs which simulate woven effects, such as checks, stripes, and plaids, but which can be produced by printing at lower cost and with greater latitude in execution of the design than colored-yarn mills could obtain. In fact, it was the limitations as to design that could be produced in colored-yarn effects in comparison with the flexibility of prints that put the gingham mills out of business.

In women's-wear fabrics, consumers are probably not conscious of the difference between printing on one side of the goods and woven effects which give the same design on both sides. This is partly a result of the wide use of dyed and discharged patterns in many fabrics, notably silks and rayons, which give thorough permeation of the color throughout the ground. Furthermore, the rollers employed in dress goods on blotch patterns are engraved deeply enough for the color to penetrate through the goods and prevent too definite a white-back effect.

In the shirting field, however, the situation is different from women's wear, for here prints are almost wholly imitations of woven effects. Furthermore, there is a consumer consciousness among certain groups of consumers and in certain parts of the country, particularly along the Eastern seaboard, of the fact that woven-style shirtings represent a greater value. Thus, despite the fact that prints can be sold for less money, woven-style shirtings still dominate the high-style market and easily command a premium in competition with prints. With this trade, prints make possible the production of novelty-pattern shirts for lower-price-range garments such as the $1 shirt, from which woven-style shirtings are excluded because of their greater cost.

The third use of prints, that is, their employment to conceal low-cloth constructions, is one with which all of you are familiar as something of which the industry certainly cannot feel proud. The excuse for this type of printing is that large sections of the population can pay no more than so much for goods and consequently some product must be produced at prices which they can pay. Unfortunately, these consumers do not recognize that they would get more for their money from a little better piece of cloth even though it might involve a larger expenditure at one time, and it would be hard to convince most of them that this is true.

PRODUCTION FOR SPECIFIC USES

As to definite consumer requirements, it needs to be recognized that all cloths must be merchandised for some specific use. Most converters do not put a pattern in their line simply because it is artistic or appeals to them individually. They expect it to be used specifically for certain purposes, and size of the design, size of the repeat, the way the motif is turned in the design, the number of colors, and the color combinations employed are all planned with respect to certain specific uses. Take a line of percales, for example. Such a line may contain perhaps 75 patterns of which there will be a certain number of patterns for the women's dress trade. Some will be staple small effects for mature women or for stouts, but medium-size colorful patterns for the regular lines will also be included. Also, with percales today replacing more and more of the other printed cotton-fabric lines, larger patterns for misses wear will be available with colorful bizarre effects for sports and beach wear. A certain number of additional small patterns for children's wear will also be included, with color combinations in which the basic color will be red, green, and gold, in addition to light blue. Staple designs, such as the perennial polka dots, on both white and colored grounds, and in assorted sizes, will also be in the line.

These various divisions of a line and the general principles upon which patterns are selected continue much the same from one year to the next. Superimposed upon a structure of this sort is the style trend. New style developments will require new types of motif, different interpretations of designs, new color combinations, and variations up and down the line from what has been tried in the past. On the staple lines, such as percales, radical changes in styles will be less immediately necessary than in the more highly styled lines of wash goods and rayons. There, for example, the effect of a new style development may show itself immediately. One of the Paris couturiers, for example, may launch a new mode involving the employment of a certain type of print. It may be different from existing patterns only in size or character of the motif or, more likely, it may express a new idea in color combinations, perhaps employment of some new shade which requires different tones in the other colors used in each combination.

It will not be long before printers are called upon to supply goods of this type. Higher-price and higher-style lines of silks and rayons are likely to get it first. Other converters will quickly follow. To get this effect may involve painstaking research, not simply to produce the color effect but to do so at a price comparable with other printing costs. As to when such changes are likely to occur and their extent, there is no possible way of forecasting. The only thing which can be foretold is that, regardless of their importance in the style world, they are not likely to affect materially the total volume of prints that will be used.

While other printed lines are also affected by style movements, there the changes in styles originate in other sources. For example, in the drapery field, style movements, while related in a vague way to what is transpiring in dress lines, have basically different origins. Style in home decoration and employment of printed designs in draperies tie back to period types of decoration and to style trends in architecture, furniture, and other home furnishings.

With printed shirtings, style movements for the most part originate in England and are reflected in the shirt lines of the branded-line shirt manufacturers here who more or less set the tone of style in such goods in the American market. Here, a new style trend may call for changes in width between stripes or increasing or decreasing the depth of the ground effect, or, as in the women's wear field, most often changing the shades themselves or color-combination effects. With men's suitings and slackings, somewhat the same situation holds as in shirts, for here prints are again largely imitations of woven effects.

FASTNESS OF COLOR AN IMPORTANT BUT VARIABLE REQUIREMENT

Aside from the question of shades of color and color combinations employed, is the important consumer requirement as to fastness of color. This is not the same for all types of goods, for again requirements must be related to use. Thus, for some uses fugitive colors are not only preferable but also essential. This is not generally the case with prints for the application of a printed design implies that it is there to stay. As to how long it will last, and under what conditions, no set standard exists to which all printed colors must measure up. For dress goods, the test is that of washing, whereas for draperies, it is resistance to fading from exposure to sunlight.

When comparing the types of color being employed today on printed dress goods with what were used only as little as 15 years ago, we cannot help being impressed at the change that has taken place. Then fast colors were the exception and consumers expected little more from prints than commercial colors, that is, they expected prints to last through only a few washings. This was true for most dress goods and it certainly was true of draperies. With shirts, where only a few colors were employed, the introduction of indanthrene colors had made it possible some ten years before to print these fabrics in fast colors at low cost. For the extensive range of fabrics that were used as material for dresses and where colorful effects were required, there was no alternative to using commercial colors for the popular price ranges.

Consumers seemed, however, to get along somehow with commercial colors. They may have wanted better but they simply could not be produced at prices at which the goods could be sold. Gradual introduction of fast colors and the enormous strides that have been made in perfecting brilliant shades in dyes that are reasonably fast to washing and sunlight have imperceptibly brought about a change in consumers' demands for fast colors in prints. Today consumers take fast colors for granted and will enter a claim with any retailer from whom they may have purchased goods, the colors of which do not stand up under ordinary, and sometimes extraordinary, conditions.

Even with draperies, a similar change is now taking place today. Production of fast colors some years ago was limited to the higher-priced lines. Today, it has been brought down to the point where even the cheapest cloth constructions are now being printed in brilliant colors that can be guaranteed fast to sunlight. Here, of course, the test is not one of washing but of fastness to light and the difficulties to be overcome have been much greater than in the case of dress goods where only reasonable fastness to light is required. Probably over the next few years, as new colors are developed by the dyestuff industry, consumers will come to take for granted fastness of color in all lines of draperies.

RETAIL PRICES INFLUENCE TEXTILE-PRINTING COSTS

Meeting consumer requirements does not end, however, with simply providing printed textiles in designs, styles, and colors which consumers will accept. Merchandise must be offered at the right price, and, on that score, consumer requirements are exceptionally exacting. This question of what consumers will pay for a given article is sometimes overstressed, but, in the case of most textiles which fit into the category of shopping goods, there are unquestionably certain retail price levels at which goods can be sold more readily than at others. By far the largest part of all printed textiles, somewhere around three quarters of the total, are sold to cutters-up, which means that they reach the retail counter as made-up articles with a fairly high unit price. Back in the days when the principal channel of distribution was over the retail counter as piece goods, retail-price brackets may have been less important, but, when prices get into three figures, some limit must be placed on the number of price lines that a retail store can reasonably be expected to carry.

Stores have found, in their efforts to reduce their number of price lines and to concentrate on those which fit their clientele's taste and purse, that it is not necessary to carry a wide range of goods. Thus, instead of carrying dresses at every twenty-cent interval from $0.79 to $10, stores may stock only a half dozen price lines in the whole range. One of these would undoubtedly be at the $1 level, for by some strange quirk in human nature more goods can be sold at that price, or a few cents below, than at any other price level in the whole scale. Another would be the $1.95 level, another perhaps $5.95, and so on.

To produce a printed fabric, such as a percale, for sale in a house dress at $1 retail, a cutter-up could not pay more than 11 or 12 cents per yd at the most, the exact price depending upon design, yardage, and trimmings employed. Translated back into terms of direct interest to the finishing trade, that means that there, within a narrow range, we have a top price beyond which the converter cannot sell his printed fabric, so that slight increases in raw material or gray-cloth prices may send him to the finisher to get a price reduction that will enable him to leave his finished-goods price unchanged. Or, as with some of the rayon fabrics, a reduction in finishing price may make it possible to fit the cloth into a dress selling in some lower retail-price bracket which theoretically would increase the volume that could be sold.

Of course, the consumer is unaware of all of the struggles over price and the headaches that go into turning out a dress for a certain price, but that price is as much a requirement as the dress itself. Somehow, by methods too devious to mention, the process of grinding out gray goods, finishing them, and fabricating them into garments proceeds year in and year out. Once in a while, someone in this highly disorganized finishing industry manages to make a few dollars in the process. Unfortunately, it does not happen often enough, for the profit the industry is entitled to is passed on in part to succeeding processors who refuse to work for nothing and in part to consumers in the form of merchandise at prices that consumers will pay.

The merchandising process then, throughout the textile field, is one of continually viewing the printing and finishing processes in terms of markets and their requirements, which in turn represent the requirements of consumers. Thus merchandising, which lies in between the job of manufacturing and that of selling, must eternally think and plan for the consumer on the one hand, while, at the same time, see to it that the manufacturing end of the business is kept busy, if not happy.

Here are 15 important textile markets for which a billion and a quarter yards of goods are produced each year. What do we know about these markets, about the fluctuations in consumer demand for prints, what factors retard them, what accelerate them, and what influence raw-material price fluctuations and changes in consumer purchasing power have upon demand? Study of these and many other questions that should be of genuine concern to management in the textile-printing industry must await an awakened interest on the part of printers for the collection of adequate industry statistics to which all printers will contribute.

EXPOSURE to sunlight of a glass container that is filled with equal volumes of hydrogen and chlorine gas causes instantaneous combination of the two gases, the rate of combination decreasing in direct proportion to the subduing of the light until darkness is reached and the two gases do not combine. This photochemical reaction, which has been known to chemists for a long time, is utilized by the Société Tubest, Fere-en-Tardenois, France, as the basic principle that underlies the operation of a new and interesting light relay that it is manufacturing. A small glass bulb that is filled to about one half of its capacity with aqueous hydrochloric acid and has two electrodes passing through the wall of this container comprises the relay. Passage of an electric current through the bulb results in electrolysis of the acid and the production of gaseous chlorine and hydrogen. If the bulb is in the dark, recombination of the gases fails to occur, and a considerable gas pressure is built up in the bulb, one side of which is a flexible membrane that bends slightly under the influence of the increasing gas pressure. This bending movement either operates a direct-acting switch or moves a mercury column that closes the circuit. Exposing the glass bulb to light of a certain intensity causes the two gases that it contains to recombine and dissolve in the acid, thus decreasing the pressure. This reduction in pressure against the membrane permits it to return to its normal position and the circuit is broken.—*The Engineer*, Oct. 1, 1937, p. 365.

Design Problems of MOLDED PLASTIC PARTS

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A STUDY of procedure in designing products to be made from plastics shows need for close cooperation between the engineer-draftsman and the artist. The former should, of course, indicate all technical details and various mechanical and functional factors that must be considered in producing any part or product and, at the same time, render the item practical from the standpoint of economical production. On the other hand, the artist lends his talents to creating a design and style, which will be pleasing from the consumer's point of view and employing color in keeping with the trend of the times.

Incorporation of these various factors calls for the best skill and experience to develop a product that shall at once be efficient, interesting, and economical. What are some of these factors? Use of plastics has certain limitations, just as in the case of other materials such as metal, stone, and wood. You have heard general discussions of the various plastic materials that are on the market today, and you have a good idea of their properties and the reasons for their existence. The type of plastic material that is to be used may have an important bearing on the design that will be adopted finally. This is true because of the molding technic involved with each type of plastic material. Going still further, different types of plastics, such as phenolics, ureas, acetates, acrylates, rubber, and cold mold, are produced in a great variety of forms or modifications. For instance, phenolics alone can be had in several hundred variations and each involves a special or particular molding technic, because of individual characteristics.

In turn, phenolics may be grouped in three general classes according to fillers used; cellulose, mineral, and resin. These are furnished in sheet, powder, or flake form.

Cellulose Filled. Of the parts seen by the public, 90 per cent are produced from wood-filled materials. In general, they are fabricated readily by the molder and have the fewest restrictions so far as design is concerned. Other types of cellulose filler can be graded according to length of fiber from cotton flock to squares of rags. Difficulty of molding and, hence, limitations in design, increase directly with length of fiber and size of the rag squares.

Mineral Filled. Granular-type products are somewhat more difficult to mold and handle in a molder's plant than those of the wood-flour type. In general, design limitations are greater on account of smaller shrinkage in molding and poorer flowing characteristics. In turn, mineral fillers of the fibrous type, such as asbestos, are sometimes used. The longer the fiber, the more difficult the molding and the more the designer must limit himself in design. At the risk of repetition, this classification of materials was given to emphasize that the designer must consider the specific material being used in making a part. An article that could readily be produced of wood-filled phenolic material would present insurmountable problems if a rag-filled or long-fibered asbestos were used.

All Resin-Filled. These products are relatively new. They are used where certain types of chemical resistance are required and where no fillers have been found which, in themselves, will resist the chemical solutions to be encountered. Compared with the wood-filled materials they are relatively difficult to mold. They have a tendency to shrink more in the molding operation, and, in some cases, shrinkage after molding has also been a problem.

SEQUENCE IN CREATING MOLDED-PLASTIC DESIGN

Consideration must be given to conditions of use, such as dielectric strains, arcing, opacity to X-rays, wear, mechanical strains, and the like. Creation of the design for a molded plastic part should be in the following sequence:

(1) Engineer-draftsman lays out fundamentals of the design, taking into consideration all that has been said.

(2) Artist, using the fundamentals of the engineer-draftsman, designs the piece so as to make it attractive and symbolic of whatever the needs may be.

(3) Engineer-draftsman interprets the artist's sketches by making accurate mechanical drawings of the designed part. It is essential that engineer and artist meet on common ground to accomplish the best results.

(4) A perspective drawing should be made from the mechanical drawings.

(5) After the perspective drawing is found satisfactory, or corrections have been made, a model of the article should be machined or carved from any suitable material, such as wood, cast phenolic plastics, clay, or metal. It is advisable to paint the model to represent the color of the molded part itself. Cellulose nitrate can be used to advantage in constructing models because of good machinability and the ease with which sections can be bonded by simple use of a solvent.

(6) Models should be studied carefully by artist, engineer, and production division to make certain that all are satisfied. The production man should not be neglected since his duty may be to assemble the part with others.

(7) A single-cavity mold should be produced to make the article itself of the plastic to be used. This enables such important characteristics as shrinkage, assembly, and serviceability to be determined accurately before production tools are made.

This step-by-step procedure may at first seem complicated. However, it is the simplest and surest way to arrive at a product produced of plastics which is 100 per cent satisfactory.

Rules laid down and suggestions offered will be helpful to any engineer called upon to design a product in which plastics can be used to advantage. However, every molding job has many details that can be worked out only by a thoroughly experienced molding engineer. My experience with many molders has shown that the firms who are most successfully using molded

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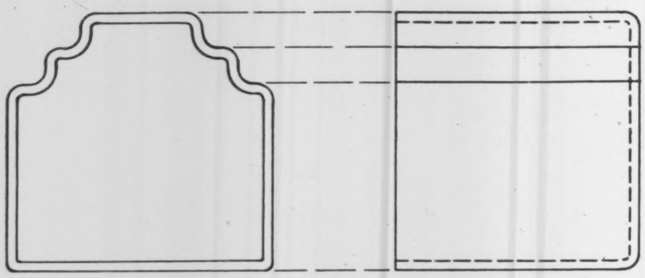
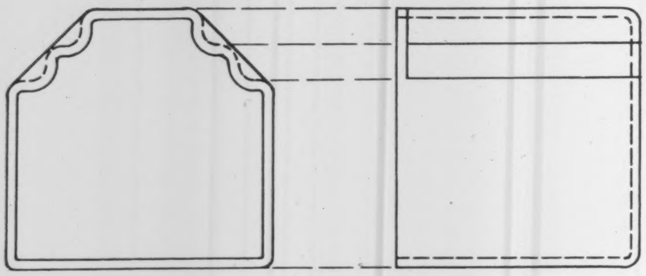
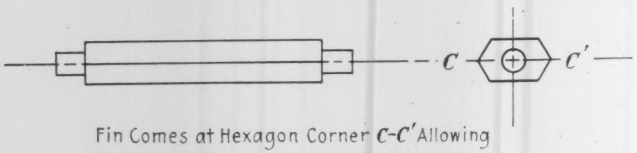
Contributed by the Machine Shop Practice Division for presentation at the Annual Meeting, New York, N. Y., Dec. 6–10, 1937, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.



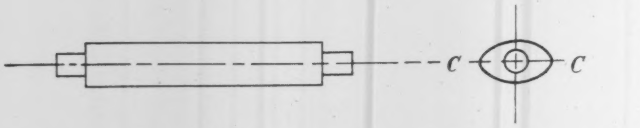
Wavy Edge at Fin Increases Finishing Cost



Wavy Edge Eliminated to Facilitate Finishing



Fin Comes at Hexagon Corner C-C′ Allowing Simple Removal and Polishing



Fin Has to be Finished at C-C′ Necessary to Remove Surface at Fin and Buff Heavily

plastics consult their custom molders while designs are still in the formative stage. I cannot too strongly recommend the desirability of going to headquarters for information. Your material suppliers may prevent serious mistakes in the selection of plastics, offer materials that are coming on the market each day, and help you do the job more adequately. Often, a skilled molding engineer can suggest a minor change or two and, even at times, can make suggestions for improving the molded piece or making it more economical to produce.

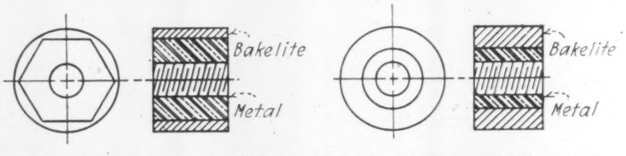
CORRECT DETAILED DESIGN REDUCES MOLD EXPENSE

Precautions should be taken to determine that the product is designed correctly in every detail before the mold is built. We cannot be too careful to avoid that overconfidence, so often found in designers or customers who believe their designs on paper are perfect and, therefore, will not produce models or single-cavity molds but proceed with production molds immediately. Experience has proved that, when molds are completed and the designer sees the actual part, he often finds that several changes must be made. This involves expensive alterations in the mold and is why models should be used. With a model or a single-cavity experimental mold, changes can be made with little expense.

To illustrate, a large corporation, in designing a new product to be made entirely in plastics, enlisted the services of a designer, and, when the design was submitted, it was readily accepted and turned over to the engineers to manufacture. The latter protested that the design was impractical and pointed out the increased mold and production costs. Their protests were overruled, and they were told to produce the piece and cut costs elsewhere. The item is on the market today and is a big seller, but the difficulties that had to be overcome in its molding would fill several volumes. With a few slight changes in design, hardly noticeable in the finished product, thousands of dollars could have been saved. Molders are constantly confronted with examples of this kind, and they serve to illustrate why molding costs are sometimes greater than they should be.

The design of a piece to be molded is of primary importance. Almost anything can be accomplished at a price, but most firms are interested in economy and facility of production. Consequently, definite restrictions are imposed on the design of molded parts and the molds to produce them. In future years, these restrictions may be eliminated or greatly reduced, just as many others have in the past. As a matter of fact, many restrictions in product design, when applied to plastics, have been eliminated recently by either new materials or methods.

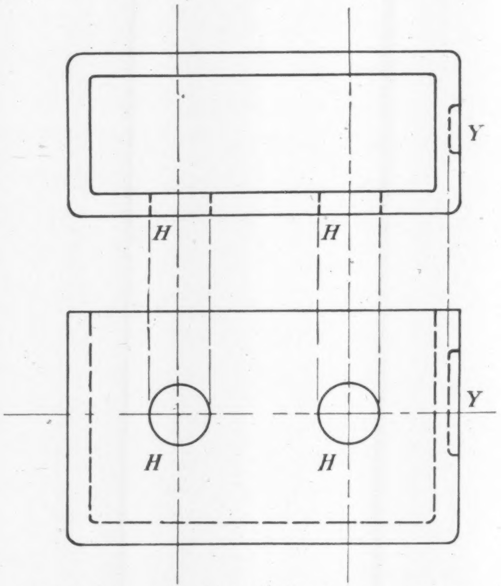
In designing products to be fabricated from plastic materials, the first principle to be remembered is to design the part so that it can be removed easily from the mold after molding is completed. When this point is overlooked, as it has been frequently, such molds are impractical for quantity-production work and, obviously, production costs are high. Proper design and simplicity of construction in the molded piece will result in simplicity in the design of the molds to be produced. The more complicated the molds, the more expensive will be



Incorrect:- Thin Walls Around and Sharp Corners on Inserts Cause Cracking

Correct:- Sufficient Wall Around a Circular Insert

Inserts May be Molded In

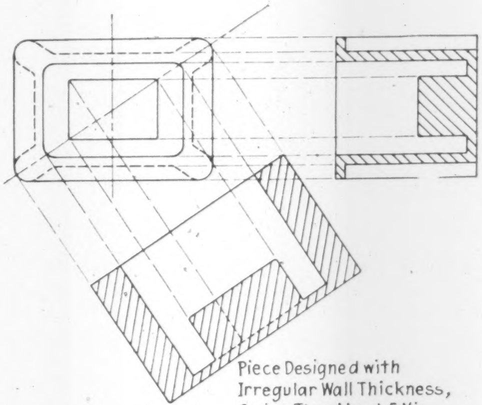


Avoid Side Holes Such as "H" or Other Undercuts Such as "Y" the production costs. It should not, however, be assumed that complicated and intricate pieces cannot be produced. They can be, and are being, turned out regularly, but the production and mold costs are commensurate with their complexity.

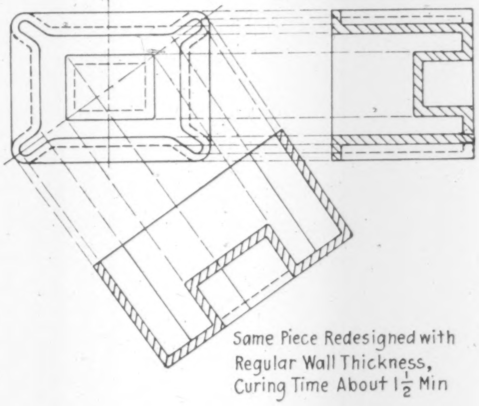
In designing any molded plastic part, whether simple or intricate in construction, certain basic details or design factors are involved. Adherence to correct handling of these factors results in good common sense in construction and will do much to assist in perfect development of the problem at hand. The more important of these considerations are wall thicknesses, allowances and tolerances, inserts and fastenings, threads, fillets, knurling, lettering and engraving, and finish.

WALL THICKNESS

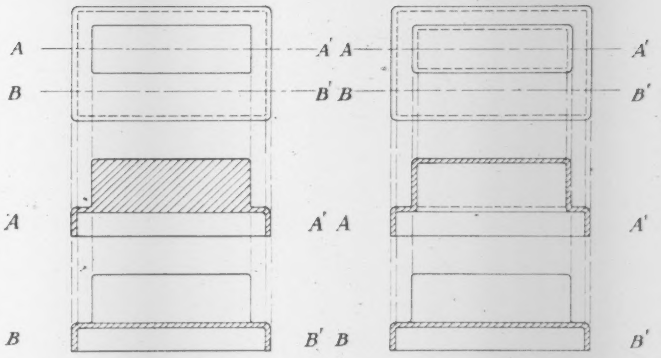
This is the first consideration in designing molded plastic parts and is strictly a matter for determination in each individual case. Proper thickness of wall construction for the piece in mind is governed by the requirements of mechanical strength and, in the case of electrical applications, that of proper dielectric strength or insulation values. Use the minimum thickness that can be employed to obtain the lowest manufacturing costs, as far as the quantity of material used is concerned, also taking into consideration that the thinner the section, the faster will be the curing time and, therefore, the greater the production from a given number of cavities. However, do not, for the sake of economy, design parts with walls so thin that parts will be fragile and their production difficult. A tendency exists, particularly in using thermosetting materials, to economize on wall sections. This is false economy, which is evidenced in molding plants by the percentage of rejects occurring in molding. Also, breakage of molded parts in assembly, during shipping, and under actual service conditions is traceable to this fault.



Piece Designed with Irregular Wall Thickness, Curing Time About 5 Min



Same Piece Redesigned with Regular Wall Thickness, Curing Time About $1\frac{1}{2}$ Min



Greater Shrinkage at A-A' than at B-B' Will Set Up Strains in the Piece

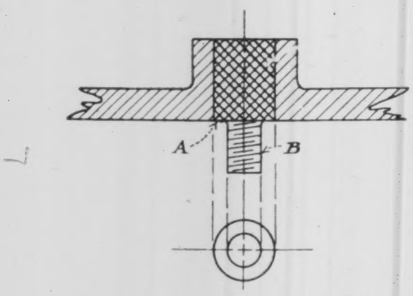
Uniform Cross Section Gives More Uniform Shrinkage; Lessens Strains

We are all familiar with the eggshell construction of items that are on the market today. Many times, items of fairly large size are made too thin in wall section, in the interest of manufacturing economy. A slightly heavier wall would do much to improve durability and create greater confidence on the part of the buying public who are, at times, skeptical about molded parts because they have had sad experiences with clock-cases or lightweight radio cabinets that have cracked in service. A minimum wall thickness of $^3/_{32}$ in. for the average box or similar item is generally satisfactory, but, on heavier parts, such as radio cabinets, clock and instrument cases, industrial service parts, or office equipment, wall sections of $^1/_4$ to $^3/_8$ in. can be used to advantage. When fabric or impact-type materials are used, or where resin board and powder or fabric are combined to give greater strength, thin sections should be avoided, particularly in parts having slots or holes on the side of the molded part parallel to the ram of the mold. Often, proper use of rib construction will permit freer flow of materials as the mold ram closes. Ribs serve a double purpose, because they act as feeders for the material and also prevent the molded part from being distorted or warped when ejected at minimum molding cycles and while still hot. They are an advantage also, in so far as they economize in material and result in faster production. Also, they eliminate heavy sections, thereby accelerating cooling of the part, and improve the appearance, as the molded pieces do not appear bulky.

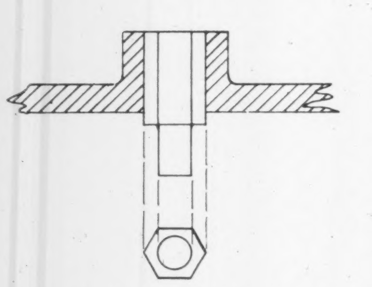
Uniform cross sections in a piece result in more uniform shrinkage and, accordingly, lessen strains both during molding and later when the part is placed in service. Also, pieces of irregular wall thicknesses will increase molding time in thermosetting materials to that required to polymerize the heaviest section as well as cooling time in thermoplastics.

ALLOWANCES AND TOLERANCES

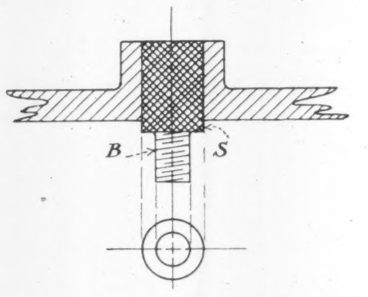
While parts can be molded with little or no allowance for draft, good practice allows 3 deg to facilitate ejection of the piece from the mold. Designers have a tendency to demand closer tolerances than are needed. It has been found that, when parts are placed in use, they would have been satisfactory and acceptable with much larger tolerances than originally specified. The designer should remember that when the toolmaker must provide for these exact tolerances in a mold, cost becomes excessive. Do not call for exceptionally close tolerances when they are unnecessary. Tolerances of ±0.002 in. per in. can be maintained on dimensions perpendicular to line of molding pressure on small pieces, but ±0.005 is considered more practical. On over-all dimensions parallel to the line of molding pressure, ±0.005 in. per in. represents about the ultimate, but ±0.008 or ±0.010 are more workable. These



Incorrect:- Material Covers Insert at "A" and Fills Up Thread, Making Cleaning Necessary



Incorrect:- Other than Circular Inserts Protruding from Piece Makes Molds Expensive



Correct:- Material will Not Pass Shoulder at "S" and Threads "B" will Remain Clean

figures are acceptable in both thermoplastic and thermosetting materials.

In designing precision instruments and apparatus, the designer often tends to employ the plastic material so that the instrument's accuracy may depend directly on the molded part. By this, I mean that over a period of time, or aging, slight changes in the molded piece may occur and definitely affect accurate operation of the instrument. Generally, the designer is prompted to do this because of economy or simplicity in assembling, but, in most cases, we have found this to be dangerous. Such a design problem might be illustrated by a barometer where it is proposed to use plastics for the housing or case. This can be accomplished satisfactorily, however, if the working parts are assembled as a separate unit and simply encased by the plastic molded shell. This procedure will tend to eliminate rejections and dissatisfaction on the part of the instrument manufacturer. It will give him a steady flow of parts at reasonable prices both as to tools and pieces and avoid expensive mold adjustments.

In the problem of tolerances, cooperation between the designer and the molder should be complete. Purchasers of molded articles should not hesitate to give full details regarding important dimensions and desired tolerances and should supply any useful information relative to the service that the part will be called upon to fulfill. On the other hand, molders are usually ready to point out any slight modifications in design which will permit easier molding and reduce the price. Much time and money can be saved by a common-sense approach to the accuracy necessary in producing parts to meet successfully the applications for which they are intended.

INSERTS

Use of inserts is important in so far as it permits inexpensive assemblies and develops a valuable function of molded plastics. They may be of metal, fiber, paper, or premolded plastics, and a multitude of other materials that lend themselves readily to the specific problem at hand. By using inserts, simpler assemblies can be made which are inexpensive and strong.

The first point to be considered is that metal inserts should be positioned vertically in the part, since this facilitates molding because fundamental motion of the mold is down and up. Care should be used to hold dimensions of inserts to close tolerance so that they can be placed in position by a slight driving fit. This is particularly true when they are placed on top of the piece. Of course, inserts can be molded horizontally, but such inserts should be kept as short as possible. Do not call for blind holes or inserts in the sides of pieces where depth of hole or length of insert is greater than twice the width. Do not try to use long, slender core pins or inserts. They will invariably be sheared off or distorted by the pressure exerted upon them during molding. If using a long insert, preferably of large diameter, is necessary, support it from two or more positions. This course is necessary when one considers that we are working with a pressure of 1 ton per sq in. or more on the molded cross-sectional area. During closing of the mold, pressure at any one point may be much higher. Of course, in molding thermoplastic or thermosetting materials by the extrusion or transfer process, the pressure exerted builds up gradually and uniformly following more nearly the laws of hydrostatics.

In screw-machine production of metal inserts for molded parts, particularly from round rod, proper anchorage, which is easily accomplished by knurling, should be provided. Use a cross or diamond knurl that is fairly coarse and at least 0.010 in. deep on the section of the insert to be embedded in the material. Where square or hexagon rod is used for inserts, grooved undercuts are necessary, and these should be of sufficient depth to insure firm embedding in the molding material. If, however, the hexagonal part is shown protruding from the piece, a hexagonal hole in the mold is required which increases the expense of building the mold. Do not use square or hexagonal portions above the surface of the molded piece, unless absolutely necessary. Turn down a shoulder on the protruding piece so that it is cylindrical in shape, as a round hole can then be used in the mold.

Metal inserts of large dimensions necessitate taking into consideration differences in the coefficients of expansion of the metal and the plastic in which it is imbedded. Cracking may occur immediately after molding, or later in service, when consideration is not given to the fact that shrinkage of the plastic around an insert creates a stress in the former.

Appearance of metal inserts can be improved by plating them with nickel, chromium, cadmium, and similar metals. Plated inserts can usually be used without any destructive effects by reaction of the plastic material during molding.

When using inserts in a molded part, care should be taken that they are not placed too near the edge of the object being molded. Do not use shell-like wall sections around inserts. Provide sufficient wall thickness so that cracking will not result on account of differences in the coefficients of expansion of the plastic and the metal.

Metal inserts are frequently used as electrical contacts. Be sure to provide air gaps at the point of flashing or arcing so that no chance is afforded for burning, carbonization, or disintegration of the plastic and final breakdown of the equipment in which the molded part is used. Proper selection of the plastic is, of course, of primary importance in designing equipment that is subject to electric-arcing problems. Confusion as to the use of plastics for power arcs, as against low-amperage arcs such as magneto or ignition applications, is frequent. Go to headquarters, consult your material suppliers. Inserts comprised of hard fiber or track rubber to prevent short circuits at points of contact are desirable but should be confined to applications where brush or wipe-spark problems are present. Use of a sufficient air gap is better design.

Thermosetting plastics are successfully used in motor commutators. This is accomplished by designing the metal commutator bars so that lugs are provided around which the material is molded. In this way, the metal bars interspaced with mica are firmly embedded in the molded core.

Another method employed in positioning inserts is to place or force them into suitable cavities provided in the molded piece after it is ejected from the mold. In this way, the molding is shrunk around the insert so that, when room temperature is attained, the inserts fit tightly in the molded parts. This method can be successfully used for inlays and for decorative work on molded pieces.

For complicated insert molds, such as multiple spring relay banks that are used in telephones and other electrical instruments, extrusion molding is recommended, either in thermosetting or thermoplastic materials. This is necessary to eliminate the distortion which may take place in the compression type of molding.

FASTENINGS AND HINGES

A type of fastening that should be carefully considered and has many advantages, is hardened, self-tapping screws, which are made in a great variety of shapes and sizes. This material is suitable for fastening covers to base units, also handles, hinges, knobs, and name or instruction plates to cases or housings made of plastics, or, in the assembly of metal parts to plastics. This type of fastening has much to recommend it. With the drive or self-tapping screws, metal inserts embedded in the material are often unnecessary. Using pins in the mold provides proper-diameter holes; thus, tapping before inserting these screws is not necessary. Tapping is slow and costly, and tapped threads in molded plastics are weak. Threads are easily crossed, and reinsertion of screws quickly breaks them down. Self-tapping screws provide a better hold under tension, shear, and vibration than machine screws. They also have the advantage of eliminating tapped or threaded inserts, thus speeding up molding time by eliminating the period required to load the inserts into the heated cavity of the mold. In many types of small parts made in large multiple-cavity molds, open press time is a large factor, and use of these hardened metal fastenings provides excellent economy through faster production.

A problem that frequently confronts the designer is that of proper cover construction on boxes, containers, cabinets, and similar parts. Covers often have to be of a different color or another type of plastic than the box or container on which they are used, and trouble frequently arises in designing two pieces that are to fit together. Do not lose sight of the fact that shrinkage varies in different plastics or different colored plastics of one type. In constructing tops and covers, friction fit or the screw type are most economical.

Where hinge construction is desirable, three types are practical for plastic molding, when considered from the standpoint of simplicity in molding and ease of assembly. They are spring, pin, and piano hinges.

The Rathbun spring hinge is patented and is made by the Rathbun Manufacturing Company. It uses small elliptical-shaped spring-steel clips, for which small undercuts must be provided in both top and bottom of the molded piece. Assembling consists of springing the clips into these undercuts with a special clamp device. Boxes hinged in this way are extremely sturdy and the spring action holds the cover tightly closed or wide open. With this type of hinge, a box can be produced which will open as far as 90 deg.

Pin-hinge construction is inexpensive from both molding and assembling standpoints. It employs a recess in the side of the box and a molded prong on the cover. A hole is drilled through the side of the box and through the center of the prong and then a hardened drive pin is driven into the hole.

Piano-hinge construction eliminates the necessity of providing a special design in the mold. Hence, holes for the hinge can be drilled afterward. The hinge, which is made of metal, can be fastened to the molded container with rivets or self-tapping screws. In some instances, holes are molded in the box, but this complicates mold construction.

THREADS

Strong accurate threads can be molded in plastic parts. All are undoubtedly familiar with the use of molded threads for use in glass bottles or containers; also, in many applications where they are used to assemble two molded pieces in which an external and an internal thread is molded on the two pieces, respectively. The standard V-type is used extensively for regular mechanical assemblies. However, in bottle and jar caps, a special thread, adopted by the Glass Container Association of America, has been developed to give the greatest ease in putting the cap on or taking it off the bottle. In this type, a round profile is used which has been found practical in so far as it allows for the variation in cast glass threads.

Molded threads can be readily unscrewed from the steel cavity or provision can be made to have separate steel details or thread plugs which will permit removal of the casting from the mold and then unscrewing of the threaded portion. On parts of undercut design where unscrewing the molded piece from the mold is not practical, a conventional parting of the thread may be run along the center line and a sizing die run over the thread later to remove all flash or parting lines. Projecting male threaded inserts should be undercut at the base of the thread to afford a clean joint and to prevent the tendency of the flash to form around the threads of the stud.

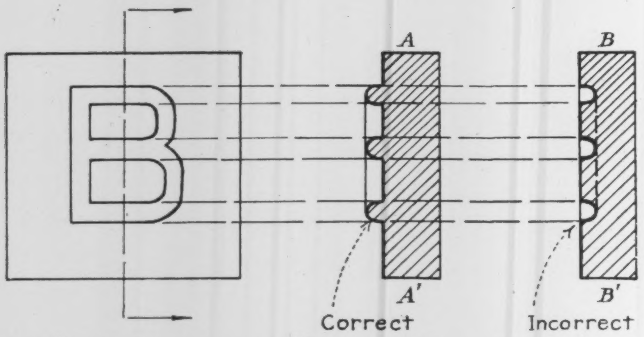
Good practice indicates starting the threads at least $^1/_{32}$ in. from the end of face perpendicular to the axis of the thread as it produces a more durable casting, eliminating a feather edge on the products. Not more than 32 threads per in. should be used. Another desirable point is that threaded holes should be given a slight countersink to facilitate withdrawal of thread mandrels.

FILLETS

Use of fillets is important on all molded pieces because they overcome structural weaknesses that are likely to be inherent in sharp corners. Radii or fillets should be used wherever practicable as this will increase the strength of the molding generally, simplifying mold construction and consequently reducing cost. They will also tend to strengthen mold and molded piece.

Designers should in all cases break sharp corners, particularly on inside construction, and provide a fillet or rib that will permit free flow of material around these sections. This will assist a material that is sluggish in its flow and thermosetting materials that undergo continual changes in plasticity characteristics in the short period that the press is closing. Proper radii of corners will do much to help the plastic flow into the proper position for molding. Many times molds that do not fill out the part properly can be made to function properly by adding more generous fillets or ribs in sections which will permit the plastic to flow down or up in greater proportion and thereby fill out long-drawn or deep moldings or the upper sections to which flowing the plastic material is necessary. This is particularly true in compression molding and is somewhat like the use of double gates or orifices when molding by the transfer-injection method.

Rules governing fillet construction are those usually adopted in general machine-design practice or construction of sand or die



A-A'-Raised Letters on a Molded Piece Allows Engraving the Mold, a Cheap Procedure

B-B'-Sunken Letters on a Molded Piece Means Cutting Away the Mold Around the Letter, an Expensive Operation

Note:-If a Hob is Used in Building a Mold, the Reverse is True

metal castings. Fillets can be produced easily with machine cutters and also assist the toolmaker in the ease of polishing the mold surface.

Another important reason for proper and thorough use of fillets is in construction of parts which are to be hobbed. Fillets should not be used where the parting line of the molded part is involved. Such corners should be left square so that finishing will be simple and the flash or fins can be readily removed by grinding or application to a flat-bed sander. Round corners in this case also necessitate placing parting lines in a position where extracting the piece is difficult and thus increases molding costs, besides making cleaning of the mold between successive heats difficult and more time-consuming for the molder.

KNURLING

Proper knurling that is consistent with good molding practice will often improve the appearance of surface or provide a better grip as in the case of handles. In the use of knurling, the fluting should always be placed at right angles to the parting face of the die so that it can be readily withdrawn or ejected. If, intricate design makes this impossible, using side cores on which the entire knurl effect is hobbed or machined is practical. Matting or stippling of any desired design or pattern can also be used as a background for engraved characters or letters.

In the use of knurling, shaping or milling to great depth is not necessary for proper handling of this work. From 0.003 to 0.005 in. will give the necessary effect and light deflection without great expense in tool work or necessity for hobbing.

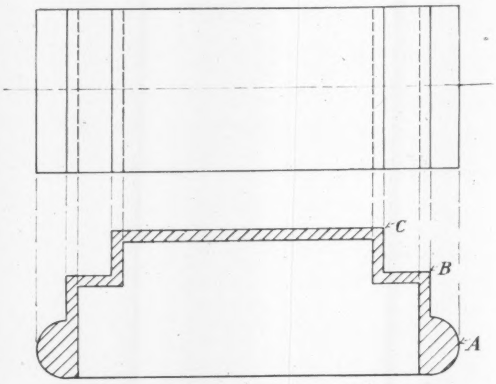
Knurling can often be used to advantage to assist in removing long thin pieces with inside or outside threads by making the knurl act as a key. This permits using a socket wrench to turn or unscrew the piece from the cavities.

LETTTERING AND ENGRAVING

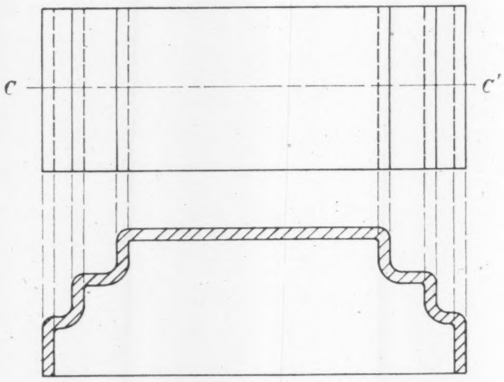
As we progress in our design of plastic parts, we come to the problem of engraving, lettering, and the surface finishing of the parts that is necessary to produce an attractive finished molding. We will, therefore, discuss first, methods of producing molded parts that have decoration and lettering on their surfaces.

Little relief may be necessary to make surface decoration or lettering stand out. Letters raised $^{1}/_{64}$ in. are easily read because they catch sharp high lights; $^{1}/_{32}$ or $^{3}/_{64}$ in. is almost the maximum to be used on medium-sized molded parts. Fluting or decorative ribs need to be raised only slightly above the surface to catch the light and produce the desired effect.

Bas-relief of lettering and engraving is preferable to reverse intaglio because of saving in tool costs. Raised letters or figures give the desired effect by engraving or carving the design in intaglio in the mold surface, and the molded piece, thus produced, shows the lettering in relief. On the other hand, where the specification calls for letters or figures in intaglio on the finished piece, it is necessary to begin with the highest point in relief on the design and cut away from that to the flat surfaces of the molded part. This, of course, involves much greater skill, often requires considerable handwork, and, of course, greatly increases tool costs. Of course, nongeometrical designs in bas-relief or in intaglio can be produced today by other means than hand engraving. Engraving or pantograph machines will rough out all kinds of freehand design, using brass or white-metal masters to guide the cutting tools, which permits wood carvings and clay or wax originals to be used as either negative or positive masters for the decoration or lettering. This form of engraved surface gives the designer much latitude and permits the use of intricate freehand forms.



Incorrect Design:-"A"-Should be a Sharp Corner—as it is the Mold must be Divided at this Point. "B" and "C" Should be Fillets to Facilitate Mold Construction and Strengthen Piece



Correct Design

Hobbing, which is the process of sinking a hardened-steel replica of the piece to be molded into a softer-steel blank, offers an excellent means of producing the desired pattern either in bas-relief or in intaglio. Parts produced in this way in multiple-cavity molds are exact impressions of the master hob. Frequently a single-die cavity may be an intricate and laborious machining problem. Machining of the hob, however, may be simple by comparison and allows unlimited and rapid production of the cavities.

Intaglio lettering and engraving is frequently called for on instrument cases and panels, and a demand exists for lettering or designs that are formed by sharp or incised lines. These designs are then wiped or rubbed in with contrasting colors. Combination of bas-relief and intaglio work produce excellent effects. In using filled-in intaglio work, make sure that the cut-in lines in the molded part, which are to receive the contrasting color, are narrow. These lines should not be over $^1/_{32}$ in. so that the paint, when daubed on and then wiped off the surface, will not wipe the color out of the lines.

Many other ways are available for decoration or embellishment of plastic parts. Metal inlays or overlays that are cut from sheet metal, 0.005 to 0.010 in. thick, can be adopted. These can be held in position on the mold at the bottom of the cavity by small pins that fit into small holes in the inlays, thereby preventing the metal from moving during molding. Another method is to open the mold just after the plastic has been formed, and, in the use of thermosetting materials before polymerization takes place; that is, while some flow still remains in the material. The inlays are then placed by hand on the part in the cavity and the mold reclosed, after which the molding cycle continues. Of course, the method adopted depends on the equipment used, whether hand or automatic molds, and upon the number of cavities to be handled Another method is that of cementing the metallic designs, which are about 0.005 in. thick, to the finished surface and afterward lacquering them to prevent tarnish.

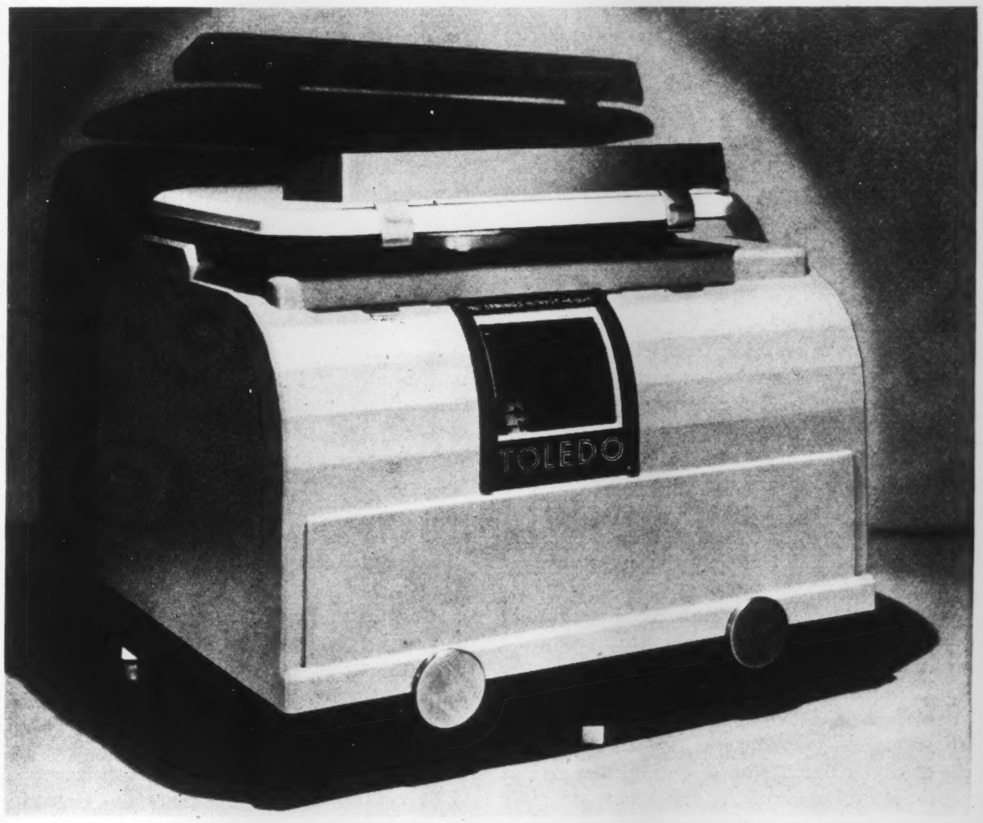
FINISH

All molded parts require a surface finish consistent with their application. Parts for industrial service or as inside functioning pieces of electrical or mechanical service need not be highly polished. For parts that require any varying degree of luster, from a satin to a mirrorlike finish, plastics lend themselves in fidelity of reproduction to the surface finish of the mold cavity. Each piece leaves the mold mirroring faithfully the luster or special characteristics of the mold surface.

A combination of surface finishes offers much to the designer in obtaining unique or pleasing contrasts. Contrasting colors or different types of plastic also can be combined to produce beautiful effects. At present, radio cabinets are on the market in which the housings are molded of phenolics, the tops are produced in urea, and the grilles are made of cellulose acetate. An almost infinite variety of combinations can be obtained and various colors employed.

Another method of finish that offers economical measures to the designer and can be employed on many products is varying the face or front of the part by substitution. For instance, one radio manufacturer has produced three models that are identical in mechanical construction. However, by inserting a plate of different design in the mold cavity, the face of each model is changed and therefore presents an entirely different effect to the buyer.

This, in brief, gives the fundamental factors that must be considered in designing any molded plastic part if the manufacturer intends to get the most and the best for his money. The subject of design is so broad that we could go on for several more hours discussing it in great detail. Things can be done today which were considered highly impractical and even improbable five or ten years ago. Undoubtedly, ten years hence, we will look back and find the same true of present practices because the plastics industry and molding technique are changing so rapidly. Serious thought should, however, always be given to product design.



TOLEDO SCALE, MOLDED IN WHITE PLASKON
(Designed by Harold Van Doran and Associates.)

CIGARETTE BOX, ILLUSTRATING THE USE OF DECORATIVE SCULPTURE

ART *in* PLASTICS DESIGN

By ROBERT J. HILL

THE GORHAM COMPANY, PROVIDENCE, R. I.

THE GENERAL use of plastics for decorative purposes is less than ten years old. Prior to ten years ago plastics were almost exclusively used for the most practical and mechanical industrial purposes with little thought of eye appeal. To date, with some notable exceptions, all accomplishment in the field of plastics is the result of engineering progress. I cannot help believing that the materials manufacturers, by encouraging a cheap market, poor designing, and cheap molding, are responsible for a certain lack on the part of the public of acceptance of plastics as a dignified material for objects of beauty.

We have not as yet had time to anticipate the possibilities for art in the field of plastics. I speak of art in the plastics field with a great deal of diffidence, because there are still those who maintain that art can only be accomplished by the individual, and I am too inclined to believe and hope that the machine can never supplant the art of the craftsman to take ardent exception to their belief. Still, the craftsman can only bring art and beauty to the few, while with the machine beauty can be made to supply all. High-speed printing presses, the camera, the phonograph record, the high-speed loom, and many other machines of modern invention and improvement have brought beauty and art into the lives of the most humble. The moving picture, with its ever changing scene, is propaganda for universal style acceptance.

All of these things that make for the more abundant life are made possible by the machine and the collaboration of experts in many fields. And so in the production of art in molded plastics, the designer, the engineer, the modeler, the mold maker, and the pressman must combine their expert talents and work in almost perfect harmony if the result of their efforts is intended to be worthy of the name of art. There can be no solo performance. Art accomplishment in machine-made quantities is the result of industrial orchestration.

THE PUBLIC DEMANDS A PLEASING APPEARANCE

Like the moving-picture producer, the plastics manufacturer, if he would prosper, must make his wares after careful study of the public's capacity for artistic understanding and acceptance. Like the moving-picture director, the designer must be sensitive to things that have a general appeal.

Today as never before in all history there is in the case of every commodity a public demand for pleasing appearance. Sales of certain common groceries have been increased because of attractive packages. Perfumes and cosmetics must be bottled, boxed, and jarred in containers as pleasing to the eye as they are supposed to be to the nose. Old wines need new bottles. Watches, fountain pens, belts, stockings, suspenders, and garters are displayed and sold in cases that are intended for re-use as trinket boxes, sandwich trays, and ash trays. The corner grocery suggests hospital cleanliness and indubitable honesty with plastics scales, meat grinders, coffee grinders, adding machines, and cash registers. All the furnishings and equipment for the office—typewriters, desks, pencil sharpeners, water coolers, filing cabinets—have been, or are in the process of being, redesigned for the sake of appearance. The electric flat iron is streamlined and so attractively designed that it looks as though it could of its own accord smooth away all the wrinkles without the slightest effort on the part of the user. Gas ranges, refrigerators, toasters, egg beaters, kettles, pots and pans, all the equipment of the kitchen, are so attractive in their modern shapes and materials that they are as smart as the appointments of the dining room. Railroad passenger travel has been increased because of streamlined trains. And the man who made the better mouse traps must needs make them

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Contributed by the Machine Shop Practice Division for presentation at the Annual Meeting, New York, N. Y., Dec. 6–10, 1937, of The American Society of Mechanical Engineers.

more beautiful to tempt the world to beat a path to his door.

Almost every article I have mentioned has made practical if not artistic use of some plastics material and hundreds—yes, thousands—of other articles will inevitably turn to plastics for reasons of economy, practicability, and appearance.

PLASTICS AFFORD A VARIETY OF MATERIALS AND EFFECTS

The many available plastics materials in all the colors, hues, and shades of the spectrum, possessing transparency, translucency, durability, and lightness, offer boundless opportunities for artistic expression. Jet, cinnabar, ivory, jade, agate, onyx, alabaster, crystal, amber, nacre, porcelain, and other materials which for ages have been vehicles for art expression have a plastics counterpart which will eventually be accepted, not as cheap counterfeits, but for their own intrinsic beauty.

Never before has the artist had at hand as many materials and mechanical aids as at present. Never before has he faced a greater need for clarity of vision, or for simplicity and sincerity in his aims. We are too enthused with possibilities for sober judgment. ~~We are too~~ close to modernism, that ambiguous word of many definitions, to discriminate as to what in modern design is epochal and what is transitional. We feel that we are preparing for a great revelation and that there is a great influence in favor of sincerity and definite purpose in all commercial design.

The approach to the problem in industrial design is essentially the same as the architect's approach to his problem. The architect does not plan a skyscraper for the man who wants a bungalow nor does the industrial designer suggest boudoir style for the office.

One of the most interesting solutions to a problem in plastics design is the housing for the Toledo scale.[1] Its appearance is very convincing of honest measure of weight. Its housing is molded of white Plaskon, a urea material, by The General Electric Company, plastics division. Harold Van Doren and associates were responsible for the design, but, says Hugh D. Bennett, president of the Toledo Scale Co., "the primary purpose of redesigning and actually remaking the Toledo scale was to lessen its weight for greater convenience in making selling demonstrations and for improved appearance and service in the retail shop. Through the use of the Plaskon housing the weight of the scale was reduced from 165 to 55$^1/_2$ lb. Large savings in shipping costs are secured. Its finish is permanent, and a number of manufacturing economies were accomplished through the use of this new plastic material. And best of all," he adds, "the new scale has enjoyed an exceptional increase in sales."

The old-style pressure cooker met with a great deal of sales resistance because of its formidable appearance—like a steam boiler about to blow up. Few housewives felt safe in using it in spite of foolproof safety devices. The National Pressure Cooker Company caused their product to be restyled with decorative heat-insulated handles of black Bakelite. The retailer reports increased sales because the newly designed cooker looks much more simple to operate and easier to keep clean.

In designing household equipment one of the most important things considered is the necessity for simple surfaces without sharp corners so that cleaning is made easier. The long wearing qualities of plastics material and its clean-cut lines combined with aluminum make fine-looking merchandise. New-styled products seem to sell themselves because the designer has given his first thought to their practical and safe use and to their appearance, so that these virtues become self-evident. These few examples illustrate the designer's approach to the problem of injecting art into articles of common utility.

USES OF PLASTICS ARE GROWING

Plastics are also finding an important place in the field of interior decoration. Furniture may be had with a permanent polish and a finish that can be maintained with little labor. Morris B. Sanders, New York architect and designer, has made his residence very effective with the general use of Formica, a laminated plastic, for dining-room refectory table, buffet, and serving shelves, bulkheads, dressing tables, cabinets, fireplace mantels, doors and wherever normal living would soon leave signs of wear and damage on less sturdy materials.

Lighting fixtures in the form of portable lights, and translucent and transparent bowls and shades which have been made in metal, glass, paper, and porcelain, are being replaced by plastic material. C. H. Sibbert, chief architect of the S. H. Kress Company, has pioneered the use of ivory Tenite for a 36-in. diameter, filigreed, ceiling-hung, lighting louver. The effect obtained would have been impossible in any other material. Glass would have been impossible because of the liability of breakage in the thin sections used. Metal would have been three to four times heavier and cold to the eye. These lights are so hung in the Kress stores that the counter display receives a strong direct light and the aisles a soft diffused glow.

The designer has also made effective use of plastics for the decoration of automobile interiors. Where he has used chromium for its conspicuous sparkle while the car is under way, the use of colorful plastics for interior door handles, gear shifts, dome lights, and dash trimmings gives a feeling of hospitality and comfort that is to be had nowhere else except at home.

THE DESIGNER'S CONTRIBUTION IS BEAUTY

I am told that there still exists among men who employ the skill of trained and experienced designers that person who boasts that he knows what he likes and persists in forcing the designer to execute his doubtful tastes. Of course, in exceptional cases this works out very well, but these cases are rare. This same man would never think of dictating his engineer's invention. He might employ a score of experts in other trainings and never presume to judge them except by their finished work. In other branches of professional training, mathematical or geometrical, means may be invoked to test the individual's skill, but how can one apply the same yardstick to the artist? The work of the modern designer must be recognized and appreciated *today*, it cannot await the artist's demise, as in the case of painters of the past, to receive appreciation and admiration in the museums of the future. It must "click" and be as timely as the beat of a clock.

What does the designer consider first in relation to economical goods? Probably the consumer's needs are given first consideration. Human needs are fundamentally based on the laws of self-preservation and perpetuation. We need food for our hunger and sex for perpetuation. We need clothing and shelter, and after these comes the spiritual need of our civilization. The spiritual need is the result of culture, and it is the designer's function to induce desire for it by an appeal to the mind. Beauty is the artist's contribution to satisfy these human needs.

Interest in the artist's appeal lies in its diversity. Diversity and variation of appeal attract men's curiosity and inspire the designer with a wish to create. He often restates what has been stated before, but when he speaks sincerely, it is rare that he does not express something new with a life of its own.

Different climates and different races have different standards of color and beauty of form peculiar to themselves in which they express their arts. Each individual is bound to express something of his background and environment. Of the difference in individual forms of expression is born personality, of collective expressions of personality is born style. Before the days of the camera, radio, and moving picture, and before the days when transportation and communication were not so rapid as today, styles were slow in changing. Centuries were lived while a style was budding. Today, the styles flower and fade almost overnight. It is possible to date a six-month old magazine by its illustrations.

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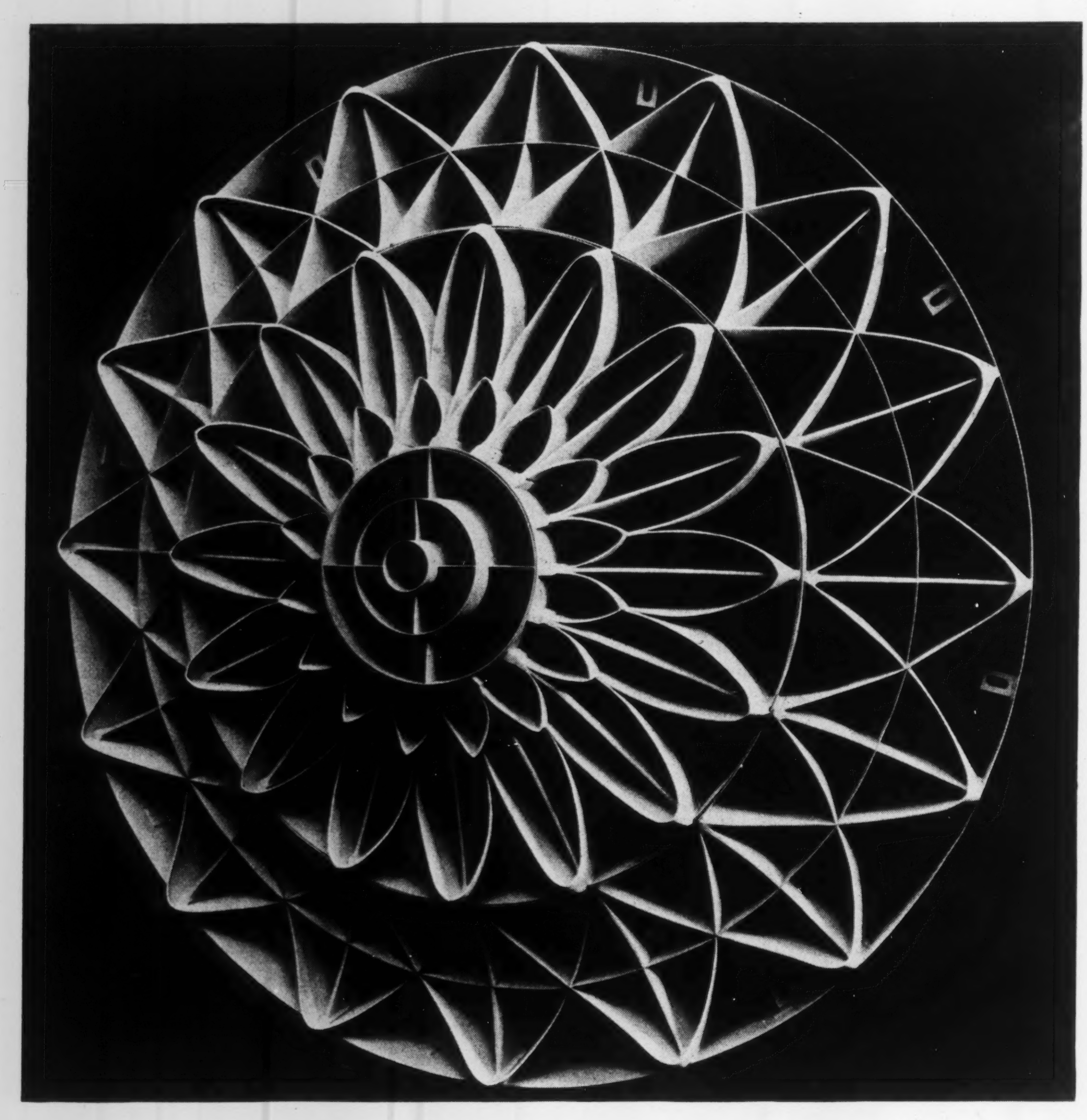
[1] See page 913.

These changing styles are the life blood of many of our great industries, particularly in the automobile, clothing, and jewelry groups. Sometimes they change too quickly. Part of our profession makes a fetish of the machine and claims that honest goods should acknowledge by form and decoration their machine origin. Why must a product bear birthmarks to be honest? I am glad to be able to purchase beautiful things cheaply because they are made by the machine, but I prefer them to bear the marks of humanity rather than the evidence that the machine can dominate beauty in my life or work. Evidences of the labor that brought forth the product tire me, they blight my appreciation.

Architects of great buildings today call on the services of sculptors. Why can't I have, at a price that I can afford to pay, a clock or a lamp or a trinket box or a radio cabinet that includes as part of its decoration a reproduction of some joyful little ornament sculptured by Lee Lawree, Paul Manship, or Paul Jennewein? I would like to be able to buy a bowl of transparent amber or ruby-colored plastics with intaglio ornament done with the spirit that is so characteristic of Swedish glass.

My prayer, as a designer, is that I be permitted to contribute my humble part to making life more beautiful and comfortable, goods more honest, and profits for my employer more abundant.



LIGHTING LOUVER, 36 IN. IN DIAMETER, MOLDED IN IVORY TENITE

PLASTICS MATERIALS

By HARRY BURRELL

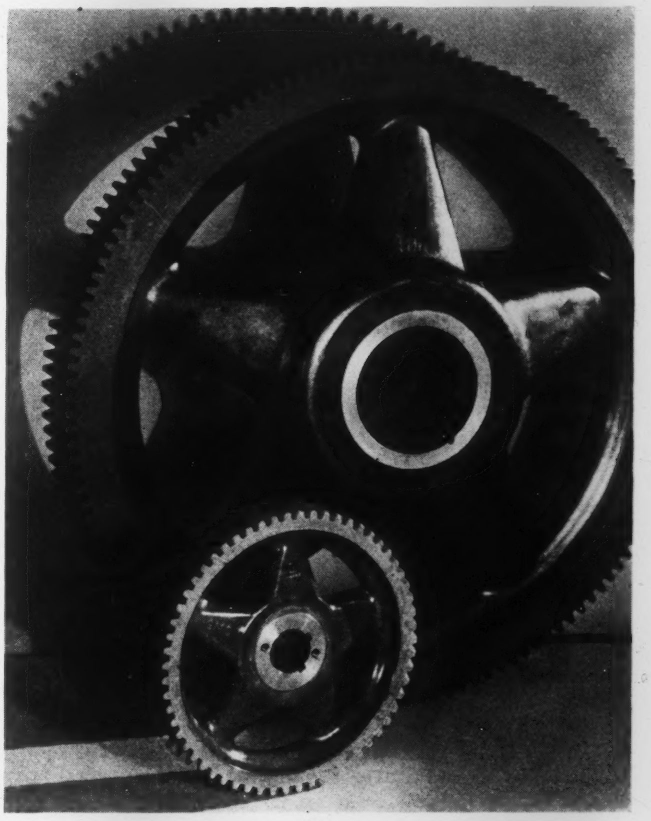
ELLIS-FOSTER COMPANY, MONTCLAIR N. J.

ALTHOUGH molding plastic materials is an old art, the technique has altered considerably since the introduction of synthetic resins as binders by Baekeland about 25 years ago. With the layman, the terms "synthetic resin" and "plastic" are used somewhat interchangeably; to be technically accurate each must be given the meaning of its proper field. Synthetic resins are used in a variety of ways as well as in plastics; an important application is that of paints, varnishes, and other coatings. Among other uses may be mentioned crease-resisting and waterproofing of fabrics, materials for fabrication of ornaments, and jewelry, e.g., Catalin, and adhesives, e.g., for plywood. On the other hand, plastics include materials other than synthetic resins, such as clay, plaster, cement, putty, and metals; for this discussion we may consider synthetic resins as merely one type of plastic material.

What is a synthetic resin? The term defies an accurate and complete definition, so the simplest and perhaps the best description is that it is an artificially prepared material which possesses, or did possess at some stage in its process of manufacture, physical properties similar to those of rosin; that is, a vitreous substance which has a gradual softening point and is fusible. This would seem to include such materials as tar or celluloid, but the synthetic-resin chemist excludes these, mainly for the sake of convenience because their study is a science in itself. What, then, is a plastic? A plastic is anything that can be deformed under mechanical stress without losing its coherence and is able to keep the new form given it. Common organic plastics in commercial use would include synthetic resins, cellulose derivatives, rubber, shellac, casein, and bitumens.

LARGE MOLECULES CHARACTERIZE SYNTHETIC RESINS

Let us consider for a moment the synthetic resins, for by examining them we may gain an insight to all the plastics. A particular resin does not consist of a single chemical entity; it is not a definite compound. It consists rather of a mixture of similar substances—so similar, indeed, that their separation and identification frequently baffle chemical analysis. One point that these substances have in common is a high molecular weight; compared with familiar substances such as salt or sugar, the molecules of a resin are giants in size. This special feature helps to endow the materials with plastic properties. The aim of every resin chemist is to build up his molecules to a large size. This is done in a variety of ways which will presently be pointed out.



MOLDED CELORON SPOKE GEAR

(The Studebaker Corporation, South Bend, Ind. Third Award, Industrial Group, Second Modern Plastics Competition. Designed and manufactured by the Continental Diamond Fibre Co.)

To understand why this effect takes place, let us resort to a rather homely analogy. Imagine we have a container full of rice, each grain representing a small-size molecule. If we double a fist and plunge it energetically with a directly downward motion into the container, we may force our way through the grains of rice, causing them to slip over one another and, in a sense, to flow so that the fist can reach the bottom of the container and become covered with rice. This represents a permanently plastic material. Imagine next, a succession of containers filled with dried peas, marbles, and apples, respectively. They represent materials of progressively larger molecular size. It will be seen intuitively that, as the particles become larger, forcing the fist into the container becomes more difficult until, with the apples, whether we could penetrate at all is doubtful. This illustrates aptly that as molecular size increases, ability to flow under pressure decreases.

Carrying the analogy a little further, suppose we place the container of apples on a device that will vigorously shake it so that each apple is tossed around, knocking against its neighbors and the walls of the container and occasionally flying out at the top and falling back again. This time if we try to plunge a fist into the container, we will eventually penetrate for the agitation of the apples has the effect of holding them more loosely and tends to eliminate the friction between them. This resembles a plastic that becomes soft on heating (the heat being analogous to tossing the "molecular apples") so that it will flow, but that regains its solidity on cooling; in other words, a thermoplastic substance. All plastics, natural and synthetic, behave in a fashion similar to this.

POLYMERIZATION AND CONDENSATION PRODUCE SYNTHETIC RESIN

We will now examine briefly the chemical nature of synthetic resins. Little correlation exists between the chemical make-up of a substance and its ability to be transformed into a resin,

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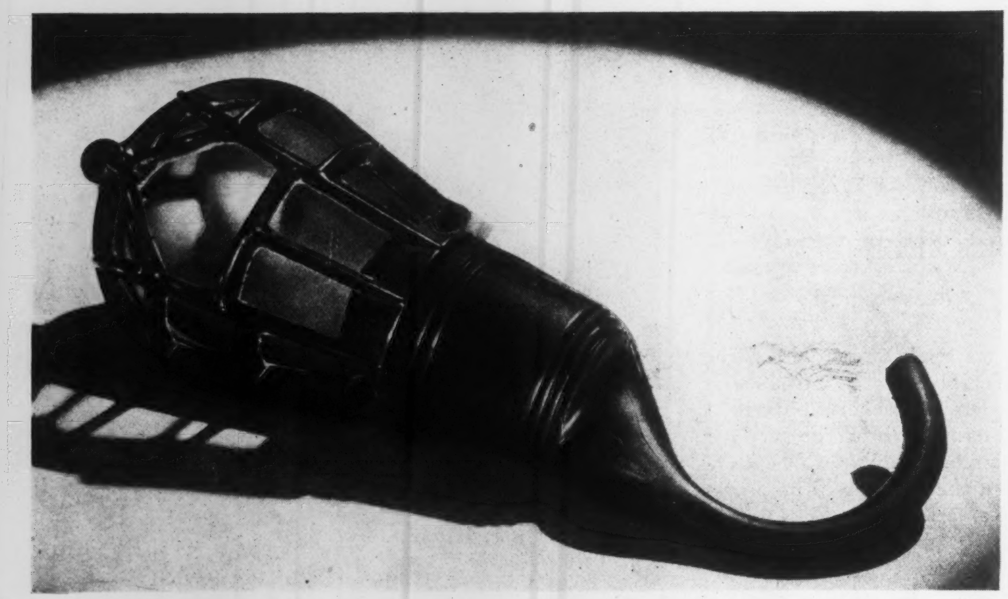
Contributed by the Machine Shop Practice Division for presentation at the Annual Meeting, New York, N. Y., Dec. 6–10, 1937, of The American Society of Mechanical Engineers.



LAMP GUARD CAGE

(McGill Manufacturing Company, Valparaiso, Ind. Honorable Mention Award, Industrial Group, Second Modern Plastics Competition. Made of Insurok by the Richardson Company.)

for resin-forming reactions occur in a wide variety of chemical classes. The main aim of the chemist is to produce a substance of high molecular weight, and this he does in two general ways, polymerization and condensation.

Polymerization occurs where molecular unsaturation exists. This may be pictured as each individual molecule sitting complacently with its hands folded; at a given signal, furnished by heat or a catalyst, each molecule bounds into action and joins hands with a neighbor. If an individual joins both his hands with those of another individual, the reaction stops there with the formation of a dimer, or a pair, with only double the molecular size, and no resin is formed. If the molecules have any sense, however, they will join hands with a neighbor on either side so that a long chain of units is built up, thus increasing the molecular weight manyfold. This is what the chemist calls "forming a linear molecule."

Condensation occurs in a different fashion. It may be imagined as a sort of pairing operation in which the molecules are girl and boy monkeys who join hands with only a member of the opposite sex. In this way, straight chains can be built up with the units of alternate kinds. Monkeys have prehensile tails so that an individual from one chain may "hook tails" with an individual of another chain. It may readily be seen that molecules of a large size can be formed which constitute an immobile system. By carefully controlling the reaction, the equivalent of chains only can be preliminarily formed and the chains welded later. This is what is done in a thermosetting composition, where a partially reacted resin is molded while still in a plastic state and continued heat in the presence of a catalyst "cures" it to an infusible state. In reality, of course, the process is not as simple as all this, and combinations and alterations of the two molecule-building processes occur. When molecular condensation takes place, a by-product, such as water or hydrochloric acid, is also obtained. The picture will perhaps become clearer by discussing specific cases.

So far we have been considering only the resinous constituents and not the plastic composition as a whole. Except where transparency is desirable, the binder, whether a resin or not, is intimately mixed with a filler and usually with pigmenting and lubricating and sometimes catalytic substances as well. Ordinarily these are considered as merely physical mixtures, but X-ray spectrographic evidence shows that a chemical combination occurs between binder and filler at least in the case of urea resin and cellulose. The filler thus serves not only to cheapen the cost, since binders are relatively expensive, but also imparts valuable physical properties to the finished plastic; therefore, fillers should not be considered as adulterants but as a necessary constituent of a plastic. Common fillers are wood flour, asbestos, diatomaceous earth, purified wood cellulose, cotton flocks, and shredded fabrics. Depending on permissible color, desired shock resistance, fireproofness, and allowable cost, the choice of fillers would vary with a particular application. Each type, of course, has various grades.

PERMANENTLY FUSIBLE PLASTICS

Plastic materials may be conveniently divided into two groups; (*a*) the thermoplastic, or permanently fusible, and (*b*) the thermosetting, or temporarily fusible types. The first subdivision of the thermoplastic class comprises those substances that have been polymerized by virtue of their unsaturation and may be termed the vinyl type, because they are all chemically related to the vinyl resins, which includes styrene, cumarone, and the acrylates. In the monomeric state, these are all free-flowing liquids or gases; they are presented to the plastics trade in the polymerized state and are, in general, characterized by transparency and light color.

Vinyl Resins. The common vinyl resins, such as Vinylite and Mowilith, are polymerized vinyl esters, usually the acetate or the chloride or mixtures of them. They are made directly or indirectly from acetylene, the gas that is generated by the action of water on calcium carbide. Vinyl acetate, for instance, can be prepared by passing acetylene into water-free acetic acid in the presence of a mercury salt at low temperatures. This produces a volatile liquid possessing a fruity odor. It can be transformed into a solid by exposure to sunlight or by heating in the presence of a catalyst, usually an organic peroxide. As the vinyl resins are produced, they have the appearance of a light fluffy powder; this is melted down to give a water-white, glassy solid that is odorless, tasteless, and nontoxic.

Flammability and solubility in various organic liquids vary with the ratio between chloride and acetate, those with more chloride being less flammable and soluble. Properties that make vinyl resins especially valuable for moldings are high tensile strength and extremely small shrinkage, thus allowing accurate reproductions from carefully made dies. The conditions required are about 250 to 275 F and 1500 to 2000 lb per sq in. for the unfilled materials, with an increase up to 300 F and 2500 lb for the filled.

The small shrinkage accounts for its large use in records for electrical transcription of radio programs because of the excellent fidelity of sound reproduction with a low noise level. Such records do not warp or shrink, are substantially unbreakable, have a longer life, and permit placing the sound tracks closer together so that a longer program can be recorded on a record of given diameter. Dentures have proved another field where vinyl resins have been found applicable. The light color permits natural pink shades to be obtained and the resins are resistant to oral liquids and nonirritating to mouth tissues. An interesting use, although not in the plastics field, has been to furnish an impervious lining for beer cans.

Polystyrene. Victron and Resoglaz are examples of this plastic which is a chemical relative of the vinyl resins as it reaches the polymerized state through the same sort of chemical linkage. There the resemblance stops, however, for styrene is a hydrocarbon while the vinyls are esters. Styrene itself is a medium high boiling liquid with a high refractive index and an odor similar to that of benzene. It can be polymerized in the same manner as the vinyls. Production is rather difficult and costly and uses coal-tar benzene as raw material. A large chemical manufacturer recently announced the availability of styrene in carload lots, so the cost may soon be more reasonable. In appearance, polystyrene greatly resembles the vinyl resins. It has been used for dentures and is characterized by great toughness; a denture can be thrown on a concrete floor with no apparent damage. Perhaps the most distinctive property of polystyrene is its zero water absorption; this has brought about many applications to delicate electrical work because the dielectric strength does not decrease as humidity increases, as is the case with all other plastics. Disadvantages of polystyrene are its flammability, solubility in a wide variety of organic solvents, and tendency to become yellow in sunlight. Molding qualities are said to be good, the temperatures and pressures being about 293 to 375 F and 300 to 2000 lb per sq in. Polystyrene is commonly injection-molded in Germany.

Cumarone. This resin is another hydrocarbon type that is similar in chemical make-up to styrene. It is one of the first synthetic resins to be put in commercial production and has long been known to the paint and varnish trade. The fraction of crude coal-tar naphthas boiling between 300 and 400 F yields two compounds, cumarone and indene, which may be polymerized under the influence of sulphuric acid into paracumarone (or just cumarone) resin. This has not been much used in custom-molded plastics, but research has shown that it may prove a valuable compounding agent in connection with other resins and binders. It blends well with rubber, for instance, and facilitates the milling operation. As it resists weathering, abrasion, water, soap and other detergents it has been extensively used in floor tile. Electrical properties are good, little change in power factor being apparent after long submersion in water, a property suggesting its use in radio work. An important use that might be considered to come in the plastics field is as a constituent of chewing gum.

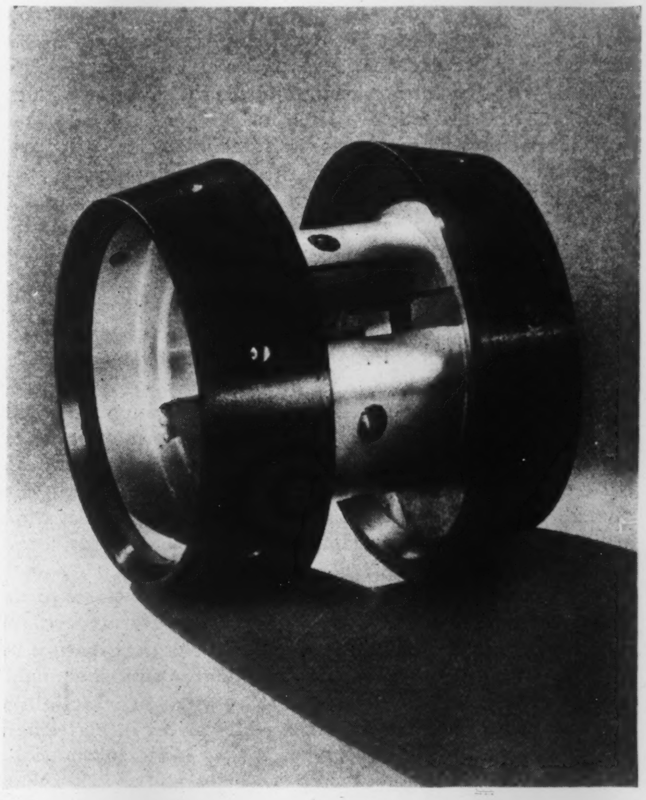
Acrylates. The last of the vinyl relatives is the group known as acrylates, of which Acryloid and Lucite are typical examples. These resins have been known and manufactured in Europe for years and quantity production has more recently been accomplished in the United States. They are manufactured by a series of complicated steps using acetone as the raw material for the methacrylates and alcohol for the acrylates. Commercial compounds are esters of acrylic acid and are principally ethyl acrylate and methyl methacrylate. By altering the proportions of the component esters, various degrees of hardness can be obtained without using plasticizers. The acrylic resins commonly seen are largely methyl methacrylate. Exceptional clarity and brilliance are characteristics of these resins which come closest of all the resins to fulfilling the chemist's endeavor to produce an organic glass. In sheet form, the material can be molded to produce windows of warped-surface shapes which have been prominently used in the modern vogue for maintaining streamline shapes. It has also been used as a center lamination in safety glass. Its principal disadvantage as a glass substitute is lack of hardness, for it is rather easily scratched. Commercial lenses and optical prisms are marketed in England, however. It is molded at between 280 and 340 F and 2000 to 3000 lb per sq in. Cost restricts the uses to novelty articles and those making the most of the clarity.

These plastics of the vinyl type, i.e., vinyl resins, polystyrene, the acrylates, and, to a lesser extent, cumarone, are valuable because their light color and clarity permit delicate pastel shades to be obtained, but, except cumarone, their high cost prohibits extensive use.

CELLULOSE DERIVATIVES

The second class of thermoplastics is termed the cellulose derivatives, of which the common ones are the esters, cellulose nitrate and acetate, and the ethers, ethyl and benzyl cellulose. The story of the invention of celluloid by Hyatt, who was searching for a substitute for ivory billiard balls, is well-known. The practical discovery here was the action of camphor as a plasticizing agent for nitrocellulose. Because of the odor of the product, many other plasticizers have come into use, and improved pyroxylin plastics are readily available at relatively low cost.

In preparing cellulose-nitrate plastics, a nitric-sulphuric acid mixture reacts on cotton linters until the cotton is sufficiently nitrated. The chemical action is not the same as occurs in



CLUTCH-BODY RING
(Brown & Sharpe Mfg. Co., Providence, R. I. Honorable Mention, Industrial Group, Second Modern Plastics Competition. Made and molded of Textolite, by General Electric.)

the vinyl type. The acids transform the naturally existing gigantic cellulose molecules into a form that is soluble in certain organic liquids, so that they can be compounded with other materials. This must be carefully controlled because the close relation of pyroxylin to gun cotton incurs danger of explosions. Cellulose nitrate is compounded with camphor, using a volatile solvent such as alcohol to aid in the mixing. The product is essentially a solid solution of the cellulose ester in camphor. After a seasoning period, the stock, in the form of blocks, sheets, rods, tubes, or similar shapes is available for molding. The multitudinous color effects obtainable with this type of plastic are well-known. It is readily workable by a variety of methods at relatively low temperatures (185 to 248 F). High flammability, solubility in a variety of solvents, discoloration, and development of brittleness on exposure to light are some of its disadvantages which are offset for many uses by its low cost. A list of applications would include such a wide variety of articles as to be meaningless except to indicate the ecumenical character. A large percentage of the entire volume of plastics trade consists of pyroxylin products.

Many years of research have developed cellulose acetate into a formidable rival to pyroxylin. Originally intended as an improved product because of its slow burning rate, it possesses other qualities that have increased the demand enormously. The steps and materials inherent in its manufacture long kept the cost at a figure that precluded serious competition with cellulose nitrate. Of late, improved methods have lowered its price so that a great many usages are extant, but it will undoubtedly never reach the basic price level of the nitrates. It is prepared in a manner similar to the nitrate, except that acetic anhydride is used in place of the mixed acid. Plasticizing cellulose acetate is also necessary before it can be molded, and several high-boiling organic substances have been developed for the purpose. Probably the largest single use is safety glass where the quality of being light-stable makes it preferable to the nitrate. High strength, toughness, and unbreakableness make it available for goggles, oil cups, and many similar uses where safety is a feature. A recent innovation is the extensive application in interior appointments of automobiles. Handles and knobs can be driven on ratchet-toothed shanks, thus saving the expense of using metallic inserts. One drawback is its susceptibility to attack by solvents.

Great promise of future development is held forth by the injection-molding process, and cellulose acetate has established itself as *the* injection-molding material. Molding conditions lie in the range of from 250 to 400 F and from 2000 to 5000 lb per sq in.; much higher pressures are required for injection molding, however. The plastic is supplied in the form of granules, sheets, rods, and blanks of various shapes, and the claim is made that certain types can be furnished at lower prices than a corresponding nitrate plastic. Interesting examples besides those mentioned are its use for lamp shades, playing cards, ornamental grilles, and transparent fountain-pen barrels.

The ethers, ethyl and benzyl cellulose, are newcomers to the market and as yet are rather untried. They are prepared by digesting cellulose in caustic soda and reacting the alkali cellulose with ethyl or benzyl chloride. The resulting compounds are more stable than the nitrate or the acetate. Ethyl cellulose, in particular, is compatible with a wide variety of plasticizers and other compounding agents; it can be made substantially nonflammable by incorporating chlorinated or phosphate plasticizers. It has a lower softening point than cellulose acetate but is tougher at low temperatures. Light affects it even less than the acetate. Electrical properties, such as dielectric strength, power factor, and surface resistivity, especially of benzyl cellulose, are better than those of the cellulose esters. Production is small—and cost correspondingly great. Present and future research work will undoubtedly make these plastics better known and encourage their commercial utilization, probably in injection moldings. The molding range is between 190 and 210 F at from 200 to 2000 lb per sq in., and the molding qualities are similar to the pyroxylins.

A third type of thermoplastic is casein. This is one of the oldest plastics, having been produced in Europe about 1904, and is obtained from the curd of cow's milk. Production has been standardized, the material being pressed into sheet or rod form and hardened or seasoned by immersing in a formaldehyde solution, and although it is not moldable in the sense that it is not available as a molding powder, it is used extensively as a cheap plastic for buttons, handles, and numerous small ornamental articles. It is worked by preheating the stock and allowing it to cool under pressure in a cold die. Mechanical operations such as sawing, grinding, cutting, turning, and carving are also used. Buttons are made by the thousand from rods by automatic machines. The colors obtainable are varied in both opaque and translucent effects.

RUBBER AND RUBBER SUBSTITUTES

Another long-used material is rubber, whose source is too well-known to be mentioned. Pure gum rubber is soft and sticky and must be compounded with sulphur and fillers to convert it to a workable state. The quantity of sulphur added determines the elasticity of the product, 10 per cent being used for soft rubber and up to 40 per cent for hard rubber. Colors are sometimes added, a common addition being carbon black which not only acts as a pigment but also enhances the physical properties as well. Antioxidants that help preserve the life of the goods and vulcanization accelerators are also commonly used. During molding, the material is said to cure because some vulcanization takes place. This is not exactly the same as in a thermosetting composition because even with hard rubber, the mold must usually be chilled before the piece can be ejected. Some products are on the market which claim to be capable of hot ejection; however, the heating cycle necessary to effect such a "cure" is considerably longer than with Bakelite, for instance. Soft-rubber compounds usually require a temperature of about 285 F at 350 to 1000 lb per sq in. while hard rubber may take pressures of between 1200 and 1800 lb per sq in. at temperatures ranging from 300 to 350 F with curing times from 15 min to 1 hr or more. Elastic properties place rubber in a class by itself which has only lately been encroached upon by the synthetic products. It is resistant to acids, alkalies, and vibratory shocks; is easily machined; and possesses notable electrical-insulating properties. The disadvantages are relatively low mechanical strength and excessive shrinkage, and warpage from die dimensions.

Certain derivatives of rubber such as the chlorinated product and rubber hydrochloride have been proposed as molding materials but are not commercially used. Chlorinated rubber might prove a valuable compounding ingredient to augment weather resistance of compositions. Rubber-hydrochloride films have been readily adapted to the manufacture of transparent umbrellas and raincoats.

When the World War cut off the supply of rubber from Germany, chemists turned their attention assiduously to the problem of synthesizing it or developing a substitute. They met with a partial measure of success, but the products were of inferior type, and production was curtailed when the Armistice permitted the markets to open to a normal supply of raw material. Research did not stop, however, and, with the incentive gained at that time, developed a variety of substitutes most of which were merely patent formulas. One, however, namely "Buna" rubber derived from butadiene, is being developed industrially in Germany. Russia also is working along somewhat similar lines. Two products survived in the United States and have grown to commercial proportions. The first, polymerized chloroprene, is chemically similar to genuine rubber; the second, an organic polysulphide known as "Thiokol," has physical properties that are similar to rubber but the chemical structure is different. The latter was the first to appear on the American market and met with immediate acceptance because of the great resistance to solvents of all types, including petroleum products, and because it could withstand years of exposure to sunlight and water and even ozone; in these respects it surpassed the natural product. It had one decided disadvantage which might have been ignored by an organic chemist but the consuming public instantly expressed its disapproval; it had a powerful, penetrating, and extremely unpleasant odor. A small object brought into a room would soon cause the occupants to leave. This defect has since been remedied, and other properties, such as maintenance of elastic qualities at low temperatures, have been improved. It is available as a molding powder and requires an average of about 3 min pressing at 300 F. This material finds wide application in gasoline and oil hoses, gaskets and packing, sheets, cups, and printing plates. Eventually it may be sold at a price which will compete with that of natural rubber.

Chloroprene synthetic rubber has been on the American market for only a short time but has met with some measure of acceptance. Like Thiokol, it is not attacked by petroleum products but like natural rubber, it is affected by other solvents, such as benzene and its derivatives. It is superior to rubber on exposure to elevated temperatures (about 212 F), but decidedly inferior at low temperatures. The main advantage over the organic-polysulphide type is its freedom from objectionable odor. Because of problems inherent in its production, it probably can never even closely approach the price at which natural rubber can be profitably sold; hence, the economic aspect is the principal deterent to its use.

THERMOSETTING COMPOSITIONS

The thermosetting or heat-hardening class of thermoplastics has furnished the impetus for the enormous development of the molding trade, for it made technically possible the mass production demanded by scientific management. When permanently fusible plastics are molded, the object must be shaped at elevated temperatures followed by a chilling of the die so that the piece can be ejected without losing its shape. This procedure results in poor thermal economy because of alternate heating and cooling of the large mass of metal comprising the dies and platens. The time required for a cycle also limits the production capacity of a given die. When thermosetting compositions are used, the molds can be kept at a constant temperature and the pieces ejected hot; this shortens the cycle and conserves wasted heat. The possibility of remolding the rejects, scrap, and flash, as can be done with thermoplastics, must be sacrificed with heat-hardened material but can be partially overcome by careful measurement of the molding charge.

Phenolics. The best-known example of the thermosetting class is the Bakelite type. The story of Leo Baekeland and how he turned into a valuable commodity the useless products of sorry chemical reactions, which caused chemists to throw away their apparatus in disgust rather than attempt to clean it, has often been told.

It is fascinating to realize that two common antiseptics such as carbolic acid, or phenol, and formaldehyde should unite to produce such a totally different substance as the resins that are thus formed. The reaction between these two constituents and their chemical near relatives has been the subject of more study than any other synthetic resin and has resulted in an untold number of patents. By varying the formaldehyde-phenol ratio and using various acid and alkaline catalysts, the reaction can be caused to yield substances with diverse properties.

In general, a molding composition is prepared by reacting the chemicals to a stage where they are still fusible. The resin is finely ground and ball-milled with wood flour, or other filler, and a curing catalyst such as "hexa" which is an alkaline compound of ammonia and formaldehyde. Another method is to mix dissolved resin and the filler, with subsequent evaporation of the solvent. The mixture, when subjected to heat and pressure, liquefies and flows so as to take the shape of the die, after which continued heat causes further reaction until the molecular growth creates a substance that is no longer fusible. Then the die may be opened and the article removed without fear of its losing its shape. Because it is difficult to obtain a light-colored phenolic resin, molding compositions are usually of a dark shade such as black or brown.

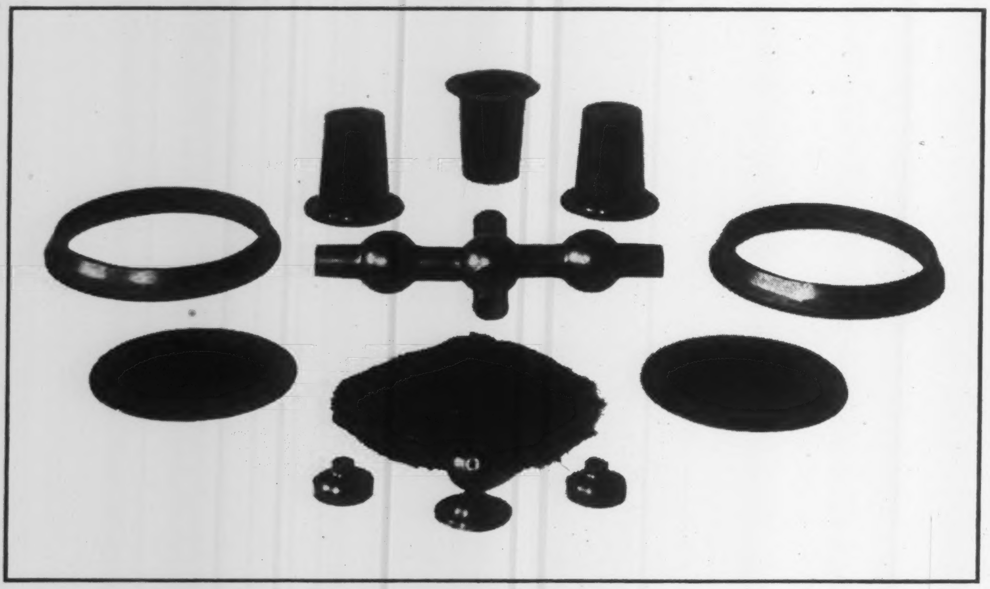
Other properties are so varied that a discussion of all of them would be well-nigh endless. Special materials that are available will fulfill almost any molding requirement and make a generalized discussion of their qualities difficult. A combination of mechanical strength and good insulating properties makes phenolics widely utilizable in electrical work. Special fillers provide compositions of exceptionally high impact, tensile, and compressive strengths. Inertness to most chemicals allows installation in contact with what might prove deteriorating and erosive conditions to other materials. So many data are readily available as to render unnecessary any enumeration of actual statistics.

Some newer applications have been in materials of construction, such as chemically resistant tanks and pipe lines, laminated sheets and built-up blocks, and veneer and plywood. Development of a transparent molding composition is also recent. Phenolics are furnished in many grades and classes and under several brand names, including Bakelite, Durez, and Resinox. Molding conditions vary with the constitution and purpose.

Modified phenolics of lesser importance are also made. These include the phenol-furfural compositions which, although dark in color, are said to possess advantages over the regular type such as better keeping qualities and greater flow; and the Ford soy-bean plastic, one form of which is a phenolic modified by the soy-protein plastic akin to casein.

Ureas. The other common temporarily fusible plastic is the urea type. When commercial application was first proposed, using the resin as an organic glass was thought possible, but cracking and crazing upon aging have rendered this impracticable. Compounding with cellulose filler for molding has overcome this objection, and technically useful products are obtained. The resin is prepared by reacting urea with formaldehyde under carefully controlled time and temperature conditions and degree of acidity. Both raw materials are manufactured synthetically and the popular press has made much of the fact that "molded objects are made from three gases" (ammonia, carbon dioxide, and formaldehyde).

The resin itself is water-white and, therefore, permits pastel shades of unlimited hues to be obtained which are light- and solvent-fast. A characteristic translucency exists which enhances the color by giving it a pleasing depth. Like phenolics, ureas will not support combustion but merely char when subjected to high temperatures. Cost is slightly higher than



"THIOKOL" MOLDING POWDER AND MOLDINGS MADE FROM IT

(Cup washers at top measure 4$^1/_2$ in. in depth, and have a flange 1$^1/_2$ in. wide. Center molding with distended center part opens the way for molding of parts hitherto necessarily made of metal. Photograph, courtesy *Modern Plastics*.)

with phenolics but materials of darker shades could probably be produced which would compete successfully. Physical properties of the molded material are similar to the phenolics, and the two may be, and often are, run interchangeably in the same die. For electrical usage, ureas have been found superior to phenolics because of the lower tendency to carbonize or "track" under arcing.

For the most part, however, the outlet for urea-formaldehyde compositions has been through media that utilize the distinct color possibilities, such as buttons, closures, handles, novelties, and premiums. Notable advances in molding design and technic were encouraged by this material, as is witnessed by large-size scale housings and illumination fixtures that have lately made their appearance. Molding temperatures are somewhat lower (from 260 to 325 F) for ureas than phenolics and the pressures, somewhat higher. Weathering resistance is influenced profoundly by degree of cure obtained on hot pressing. Molding compositions are marketed under the brand names of Plaskon and Beetle; laminated-sheet products are also obtainable and have been used occasionally in decorative and structural work.

Alkyds. A prominent synthetic resin in the coating field is the alkyd type usually prepared from glycerine and phthalic anhydride, an oxidation product of the naphthaline that is used in moth balls. Applications to the plastics field have not been commercially successful because of the inordinately long time required for cure at reasonable temperatures. Current research indicates that a new development in this field may produce a new plastic of unlimited color possibilities with a short curing cycle.

Shellac. Ordinarily, shellac is considered as a thermoplastic material and, indeed, is often referred to as the "original thermoplastic." However, continued heating for between 30 min and 1 hr brings about infusibility, and this natural product, therefore, is better described as a borderline case. As an economically priced plastic, it is commonly worked like any other permanently fusible material. When compounded with mineral fillers for cheapness, fibrous fillers for strength, and resins or cellulose esters for modifying molding properties, it is used to produce sound records in large numbers. It finds extensive application as an electrical insulator, being almost as good as porcelain and more workable, but the phenolics have largely replaced it for low-voltage and custom-molding jobs. The shellac industry has awakened to the possibilities of research and threatens to regain some of its lost prestige by compounding with curing accelerators, such as urea or "hexa," and also by fractionation of the raw lac to eliminate the softer portions. These improved compositions are semithermosetting.

COLD MOLDING

Cold-molded articles are used chiefly where appearance, weight, and shock resistance are minor considerations. The surface produced by this method ordinarily lacks gloss, and specific gravity is high because of large proportions of mineral filler. However, some of the products are nicely finished and are indistinguishable on superficial examination from a hot-molded object. The principal advantages are cheapness, high heat resistance, and fair electrical qualities. The electrical trade consumes a large majority of such items.

A cold-molding composition contains at least three ingredients; a binder, a thinner, and a filler. The first is usually a pitch or asphalt of natural origin or obtained from coal-tar or petroleum residues. Modifying agents such as stearin or drying oils are also used. A mixture of cheap, volatile solvents, such as benzol or painters' and varnish-makers' naphtha, which serve to expedite the compounding, and a heavier oil that allows cold, plastic flow comprises the thinner. Fillers increase strength, reduce shrinkage, and cheapen the final product. The loose, slightly sticky powders obtained are subjected to high pressures for short cycles and rigid but soft and mechanically weak forms result. These are carefully handled and gradually hardened by a stoving operation in which they are baked for a long time to drive off the volatile solvent. Temperatures up to 575 F yield fairly hard products, of which switch boxes and bases, doorknobs, and handles are representative.

In conclusion, the modern plastics industry has a wide range of materials from which to choose a plastic for a particular application. The choice is ultimately decided by selecting that one which will perform the service in a satisfactory manner at the lowest unit cost. Enough data are generally available in various manufacturers' publications so that the fitness of a given material can be prophesied with reasonable accuracy. The question then resolves itself into one of cost finding for the few principal contenders.

Adequate Job Training *for* ACCIDENT PREVENTION

By GLENN L. GARDINER

FORSTMANN WOOLEN COMPANY, PASSAIC, N. J.

SEVERAL serious accidents entailing permanent partial disability have marred the safety record of a department in our worsted spinning mill. They have occurred in spite of well-guarded equipment and a set of well-defined rules and regulations relating to the operating hazards in that department.

Recently an accident occurred which explained clearly why the accident record of that department has been bad for several years. The foreman lost the end of the middle finger of his right hand because he violated the strictest safety rule of the department, that prohibiting the removal of wool from the drive chain of a carding machine while it is in operation. This accident clearly revealed an attitude toward accident prevention which explains why men working under him have not respected safety regulations in the past and have consequently suffered serious injuries.

This particular foreman has rendered plenty of "lip service" to the cause of accident prevention. He has "talked a good line" in foremen's safety meetings and apparently was a good booster for safety. Fundamentally, he probably never took safety seriously, and since his men knew this, neither did they, as the accident record of the department showed. When he violated the most important safety rule of his department and lost his finger as a result, that action indicated plainer than words his superficial attitude toward accident prevention.

This case vividly illustrates the part that foremen play in accident prevention because men take their cue regarding safety from their foreman. It proves that a foreman must be sincere about accident prevention to instill the idea in his men and that adequate safety results cannot be attained unless he sets a good example. How can we get our foremen, who occupy the most important place in accident prevention, to do their safety jobs effectively?

ACCIDENT PREVENTION PART OF MANAGEMENT'S JOB

We have now had sufficient experience in accident prevention to know definitely that the effectiveness of a safety program will not rise much above the level of management's active interest and participation. Men will be as interested in safety as their foremen who will show only as much interest as the superintendents display and these, in turn, will become interested when management is emphatic in its actions on safety.

The supervisory organization is an arm of management reaching down to the very roots of accidents. It is only natural that foremen will "put the pressure" on those factors upon which they receive pressure from management above. If management stresses other functions of the foreman to the exclusion of accident prevention, he will neglect his safety responsibility and in doing so management shares in the neglect.

While the "top" management cannot escape its responsibility for preventing accidents, admittedly, a limit exists on what top management can do in actually stopping injuries to workers. All those with a background of practical experience in industry realize that there is great truth in the statement that "the best safety device is located above a workman's ears." In other words the whole success of accident-prevention activities in an organization depends, in the last analysis, upon the extent to which the worker is made "safety conscious."

The worker's personal interest in safety cannot be aroused by any chief executive sitting in the front office. The foreman who represents that executive is the one upon whom the actual safety job must finally depend. Since a worker becomes an habitually safe worker only as the result of continuous safety education, it is obvious that any continuous process of safety education must be conducted by some one who is continuously in contact with the worker. This person is inevitably the worker's foreman.

No matter how deep the top management interest in safety may be, it must depend upon its foremen for the actual doing of the job. The safety job is a part of the whole job of the worker and that comes under the foreman's supervision. No one else can do the job but him. Many things can be done to assist the foreman in doing his safety job. There is no way of doing the job for him.

THE SAFETY ENGINEER'S JOB

If the safety job is up to the foreman, one may ask, "Where does the safety engineer come in?" Personally, I believe that we must revamp our ideas somewhat as to just what is the safety engineer's job. In far too many organizations management has felt that it could delegate the entire responsibility for accident prevention to one person designated as the company's "safety engineer." But, any safety engineer who is honest with himself will soon conclude that it is more than a one-man job.

If he assumes the responsibility for the safety job, the safety engineer will soon find that the foremen are perfectly willing to "pass the buck" to him. My conception of a safety engineer's proper function is to serve as a follow-up and service man for the foremen. Safety is the foreman's responsibility, while the safety engineer is a staff executive ready to help with safety details and carry through on safety recommendations made by foremen and available for the maintenance of company-wide accident-prevention facilities. The safety engineer must be essentially a safety educator of the entire organization. Part of his job is to handle all the paper work connected with safety and administration of compensation cases. He should serve much as a safety consultant to the various departments of the organization. He should gather accident statistics, analyze them, and put them in useful form for the foremen. If the latter feel that some kind of interdepartmental safety competition would arouse and maintain interest in safety, then it becomes a safety engineer's function to manage such a campaign

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for the foremen. Such accident-prevention ideas as the safety engineer proposes to initiate should be suggested to foremen and he should help put them into effect.

Too often a safety engineer has been given the accident-prevention job of the company and top management has expected him to get results. But the management does not give the safety engineer sufficient authority over foremen to enable him to put all of his ideas into effective operation. Perhaps it is not feasible to give the safety engineer such authority because such authority would certainly conflict with the authority of line executives to whom the foremen report. Therefore, it is more logical that the line organization participate in the safety activities and put the necessary "pressure" on the foremen, while the safety engineer functions in a staff capacity to help the line organization with safety jobs.

EQUIPPING THE FOREMAN FOR HIS SAFETY JOB

Equipping a foreman for his safety job involves, (*a*) proper training in effective methods of accident-prevention work and (*b*) furnishing him with such facilities as safety bulletin boards; effective posters for departmental display; printed copies of safety standards, regulations, rules, and instructions for distribution; and well-defined methods for putting into effect such recommendations as the foreman may offer for safeguarding machinery and removal of plant hazards, and obtaining the necessary safety equipment for the use of workers on hazardous jobs.

Nothing will kill a foreman's interest in safety any quicker than poor service in carrying out his recommendations. If a foreman puts in a requisition to have a dangerous hazard properly guarded and then has to wait for months before the job is done, he will assume that management has little sincere interest in safety, particularly if a requisition put in at the same time to take care of some production requirement is handled promptly and with dispatch. An experience of this kind will counteract all the verbal emphasis that executives may put upon the importance of safety. The safety engineer of an organization can perform no more important function than acting as a follow-through man to see that foremen's recommendations and requisitions are promptly attended so.

WHAT THE FOREMAN MUST DO TO MAKE HIS DEPARTMENT SAFE

To eliminate accidents on operations that he supervises every foreman must take a number of definite steps. These may be summarized as follows:

Step 1. Make a regular practice of carefully and thoroughly instructing every new man, and every old man on a new job, with reference to every possible hazard connected with the job. These safety instructions should occupy the same position of importance as other instructions given to the worker regarding his job and having to do with the way his work is to be done. How to instruct men effectively is something that every foreman should be trained to do. The subject of "how to instruct" should be an important part of the safety-training program carried on with the foremen of an organization.

Step 2. The worker's safety training should not stop with his original instructions from the foreman, but a continous process of safety education should be carried on. This can be done in the day-by-day contacts between the foreman and his men and it can be done through effective safety posters that depict possible consequences of unsafe working practices, organized safety committee work, safety suggestion systems, and distribution of safety literature.

Step 3. The foreman should develop a program of systematic safety contacts with each of his workers. Many go so far as to keep a regular record on which they check off these contacts. Thus, over a period of a week, two weeks, or a month, the foreman takes time to stop and talk to each worker about the safety factors connected with his job. In this contact he senses the attitude of the worker toward safety and takes this opportunity to correct any unsafe attitudes. These regular safety contacts also keep men aware of the permanent and continuous interest of the foremen in their safety.

Step 4. Safety discipline must be established. This can best be accomplished by the formulation of the minimum of safety rules and regulations applying to the foreman's department These safety standards must be thoroughly impressed upon each worker and must be rigidly enforced. Any compromising on the maintenance of safety standards is certain to lead to the breakdown of these standards as well as to an increase in accidents.

Step 5. Provision should be made for mechanical safeguarding of every physical or mechanical hazard. Although statistics indicate that not more than between 10 and 15 per cent of accidents can be prevented by complete safeguarding, the psychological effect of this practice goes a long way toward establishing the fact among workers that the company is sincerely interested in safety. Complete mechanical safeguarding helps greatly to get all concerned to appreciate the importance of safe work. To neglect obvious means for mechanical safeguarding is to set up a tremendous handicap in developing the necessary cooperation to prevent the other 85 or 90 per cent of accidents which can only be prevented by safety education.

Step 6. Regular and systematic inspection by the foreman is an essential factor in keeping his department safe. These inspections should not be confined to mechanical and physical hazards but should also include an inspection of the way each worker is doing his job to make sure that unsafe working habits are not developing. Inspections by the foreman can well be augmented by some system of inspection by workers or committees of workers. Foremen in an organization may cooperate by conducting interdepartmental inspection where foremen from other departments survey the safety setup of a department. This exchange of safety ideas between foremen is valuable. It helps to develop pride in each foreman in the safety work of his own department. Also it has the advanatage of getting the viewpoints of foremen who are not so close to the details of a job as a foreman is in his own department.

Step 7. Thorough investigation into the causes of and possible remedy for every accident is an essential part of a foreman's safety work. These should not be confined merely to time-losing accidents but should include minor accidents as well because every minor accident has the possibility of being a major accident the next time it happens. The same causes that result in a minor injury might just as well result in a major injury. Of course, preventive work is much better than to "lock the door after the horse is stolen." However, hazards sometimes do not reveal themselves until an accident actually occurs. It should also be remembered that every near accident is a warning which should initiate careful investigation on the part of a foreman so that preventive steps may be taken to avoid a serious accident later.

Step 8. The foreman must keep interest and enthusiasm alive in his men. This can be done chiefly by his own enthusiasm and interest in safety. It can be accomplished also by giving credit to workers who work safely and who make safety suggestions. Interest can be stimulated by posting of accident records, by interdepartmental safety contest, by safety awards, and by many other devices that serve the interest of men.

Step 9. Foremen who have subforemen, gang leaders, group

(*Continued on page 942*)

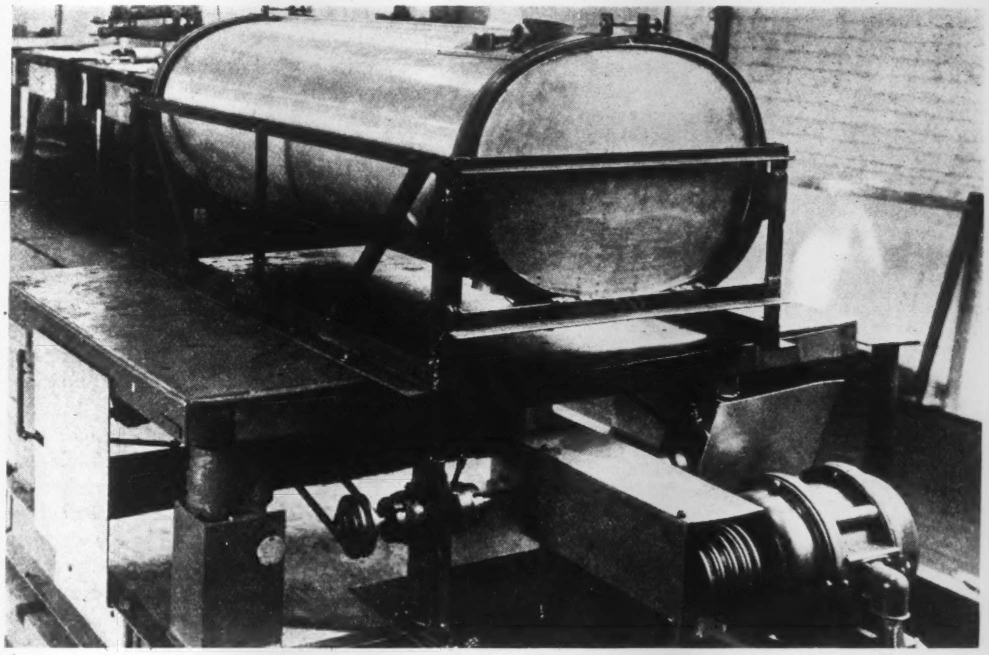

FIG. 1 SPOT- AND SEAM-WELDED FUEL TANKS HAVE A SMOOTH EXTERIOR SURFACE THAT IS FREE FROM PROJECTING RIVETHEADS

Spot- and Seam-Welded ALUMINUM TANKS *for* AIRCRAFT

By F. V. HARTMAN

ALUMINUM COMPANY OF AMERICA, NEW KENSINGTON, PA.

SPOT- AND SEAM-welding processes for joining aluminum are well-suited for fuel-tank fabrication. These are both forms of electric-resistance welding, the latter being merely a modification of the former as it consists of a series of overlapping spots that make a continuous leakproof seam. Spot welds can be used for fastening structural parts together and for fastening the skin of the tank to the baffle structure in much the same manner as rivets are used, but with the advantage that holes through the skin sheet are not needed, thus eliminating a probable cause of leaks. Spot welding enhances the appearance of fuel tanks because the exterior surface is smooth and free from projecting rivetheads as can be seen from Fig. 1. Furthermore, warping of the skin sheet of a spot-welded tank is negligible whereas welding over the rivetheads of riveted tanks results in considerable warping of the skin.

Many airplane fuel and oil tanks, as generally made up of a riveted baffle structure with a skin sheet wrapped around and riveted to it, are too complicated to be fabricated except by hand riveting, as some of the rivets may be in inaccessible locations. In fact, to reach an arm's length through handholes to drive rivets is sometimes necessary. After riveting the handholes are closed by cover plates that are welded or fastened with screws. Application of electric-resistance welding to the construction of fuel tanks has called for changes in design and construction. Some of these changes and the problems involved will be discussed in this paper.

WELDED TANKS REQUIRE MORE ACCESSIBILITY THAN RIVETED TANKS

The general construction of spot-welding machines (Fig. 2), indicates that spot-welded fuel tanks must be designed for considerably more accessibility than is necessary for hand-riveted construction. This process of joining also calls for more simplicity in construction, and the extent to which spot and seam welding can be employed will depend largely upon the design of the tank. Some tanks may be made almost entirely by spot and seam welding, but most tanks can be built more satisfactorily if torch welding is employed to some extent in addition to spot and seam.

Fig. 3 illustrates a tank that lends itself entirely to seam welding, except for two small gaps between the ends of the longitudinal weld and the circumferential welds for the heads; these two gaps are torch-welded and the operation is relatively simple. The tank may be round, elliptical, or rectangular in cross section, provided that the corners of the rectangular tank are rounded to a radius of curvature which is not smaller than the radius of the seam-welder wheels which are generally

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Contributed by the Aeronautic Division for presentation at the Annual Meeting, New York, N. Y., Dec. 6–10, 1937, of The American Society of Mechanical Engineers.

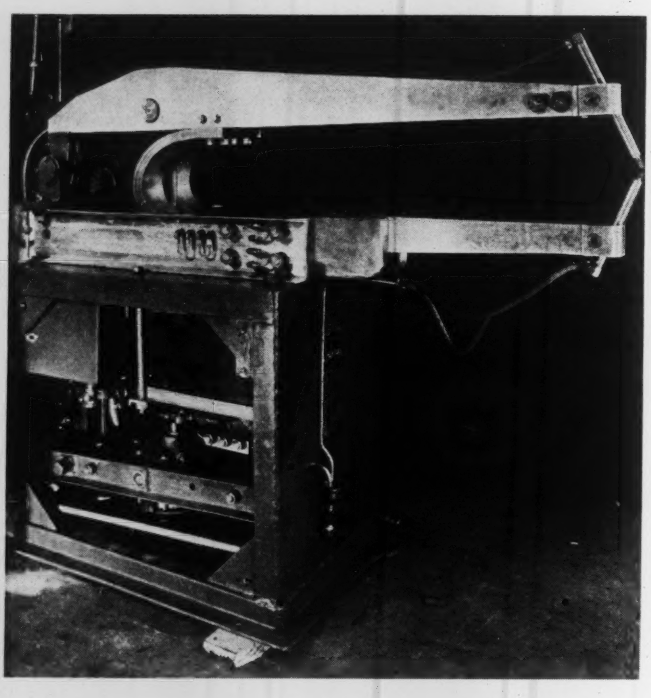


FIG. 2 MACHINES FOR SPOT WELDING FUEL TANKS SHOULD HAVE A LARGE THROAT DEPTH

about 5 in. in diameter, although smaller ones have been employed. If this type of tank is large, especially with sides that are flat or nearly so, baffles might be needed and they would be spot-welded to the skin sheet.

Before discussing baffle design and construction it might be well to consider their function. As the name implies, a baffle is intended primarily to check flow of liquid in the tank and thus minimize surging or rapid movement as the airplane changes its course suddenly. A study of the problem and observation of fuel tanks in general would seem to indicate, however, that baffles are used more for stiffening than for baffling, as they are needed mostly to stiffen the skin sheet of the tank against vibration and to give strength to the tank structure to carry the load and the internal pressure set up in the tank. Baffling of the liquid seems to be secondary. Baffles may, therefore, in many instances, be replaced with small stiffener sections. An appreciation of this condition has been helpful in designing tanks adaptable to spot and seam welding.

Fig. 4 shows a type of baffle intended for a riveted tank, before the tank was redesigned for spot and seam welding. Such a design, except for the center baffle, would be impractical for a seam- and spot-welded tank because reaching into the tank with the arms of the spot-welding machine for joining the baffles to the skin sheet is difficult. The center baffle, if assembled first, could easily be reached from each end of the tank for spot welding it to the skin, but reaching through the subsequently assembled baffles for spot welding the flange on the far side to the skin would be difficult as the operation would have to be done "blind." Spot welding under such conditions would be slow and unsatisfactory.

Fig. 5 illustrates the design of this tank as changed to make it suitable for spot-welded construction. The capacity is 250 gal and the dimensions are given to indicate its approximate size and shape. As will be noted, many of the baffles have been replaced by U-shaped stiffener sections which make the inside of the tank more accessible for spot welding the stiffener flanges to the skin sheet. The center baffle, made up of two large pans or trays spot-welded back to back, can be reached easily from each end of the shell for spot welding the flanges to the skin sheet. Stiffener sections at each end were made similar to the center baffle except that the opening in the web was made larger. This was permissible because the tank support was such that the end stiffener did not need to be as strong as the center one. Incidentally, the larger opening offered better visibility for spot welding. This tank, which is ideal for spot welding, is constructed so that the skin of the tank is stressed to carry the weight of the liquid, stiffeners being employed to keep the skin in its proper shape. They also function to break up the flat surface at each side of the tank into relatively small panels to prevent excessive vibration. A third function of the stiffeners is to give the tank structure sufficient strength to carry the internal pressure which is built up in the tank under flight conditions.

The U-shaped stiffener is ideal because it is easy to weld to the skin, its shape is symmetrical, which reduces the tendency for it to vibrate, and it may be securely fastened to the skin sheet by the two flanges. Other forms like a bulb T-section would be just as well-suited for spot welding. Unsymmetrical designs, like angle or Z-sections with only one flange for welding to the skin, are less desirable because vibration is much more apt to tear the spot welds loose.

The tank illustrated in Fig. 5 was made of 0.064-in. sheet for

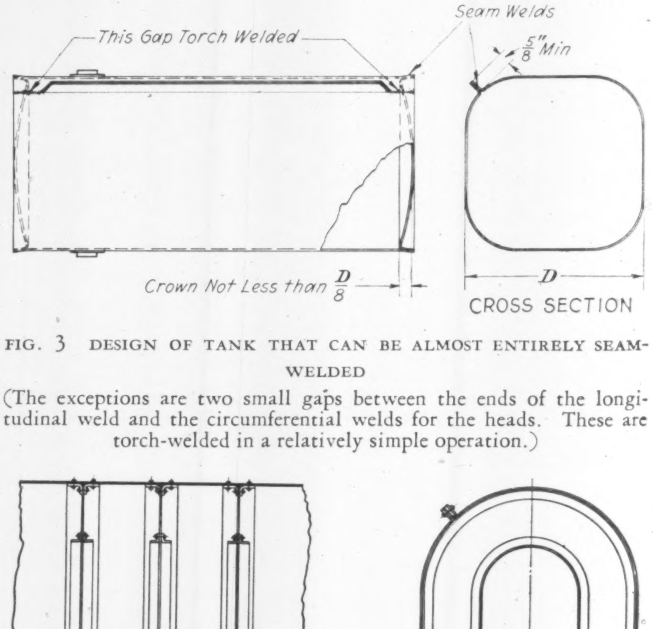


FIG. 3 DESIGN OF TANK THAT CAN BE ALMOST ENTIRELY SEAM-WELDED

(The exceptions are two small gaps between the ends of the longitudinal weld and the circumferential welds for the heads. These are torch-welded in a relatively simple operation.)

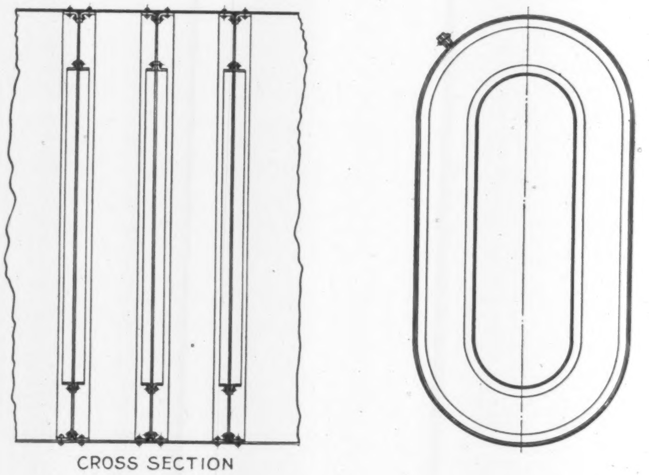


FIG. 4 TYPE OF BAFFLE INTENDED FOR A RIVETED TANK

(This design cannot be used for a spot- and seam-welded tank except for the center baffle because reaching into the tank with the arms of a spot-welding machine to fasten the baffles to the skin sheet is difficult.)

the skin and heads and 0.051-in. sheet for the stiffeners. It carried about 1700 lb of fuel and weighed only 102 lb, the unit weight being about 0.4 lb per gal. This is considered a satisfactory weight-capacity ratio in view of the fact that the tank was supported unfavorably, resting on only a single cradle.

ADVANTAGES AND DISADVANTAGES OF SINGLE-PAN TYPE BAFFLES

The single-pan type baffle, shown in Fig. 6, is well-suited for spot-welded construction and has been used in some instances. This type is assembled in the tank shell with the flange extending outward, permitting spot welding of the baffle flange to the skin sheet to be readily accomplished, and the baffles are assembled progressively, working from the center to the ends of the shell. Another definite advantage of the pan-type baffle, which can be realized where tanks are made in sufficient quantities to justify the cost of tools to form them on a draw press, is that machine-formed baffles are helpful in producing tanks to the correct size and shape because of their uniformity.

Although well-suited for spot welding, the single-pan type baffle has an objectionable characteristic which limits its use. It is unsymmetrical, with the angle shape between the web and the flange, thus making it susceptible to transverse vibration in the baffle web. Baffles of this type may, therefore, fail in fatigue in some types of tank, especially when the baffle is large. The single-pan type behaves entirely differently from the double type shown in Fig. 5. The latter is symmetrical and provides a double connection between the baffle and the skin sheet of the tank and also provides an effective stiffener at the inner edge of the web.

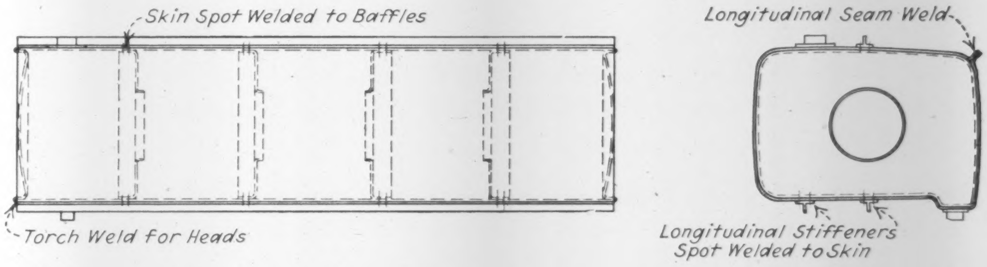


FIG. 6 SINGLE-PAN TYPE BAFFLE THAT IS WELL-SUITED TO SPOT WELDING
(This baffle can be easily welded to the skin sheet as the flange extends outward.)

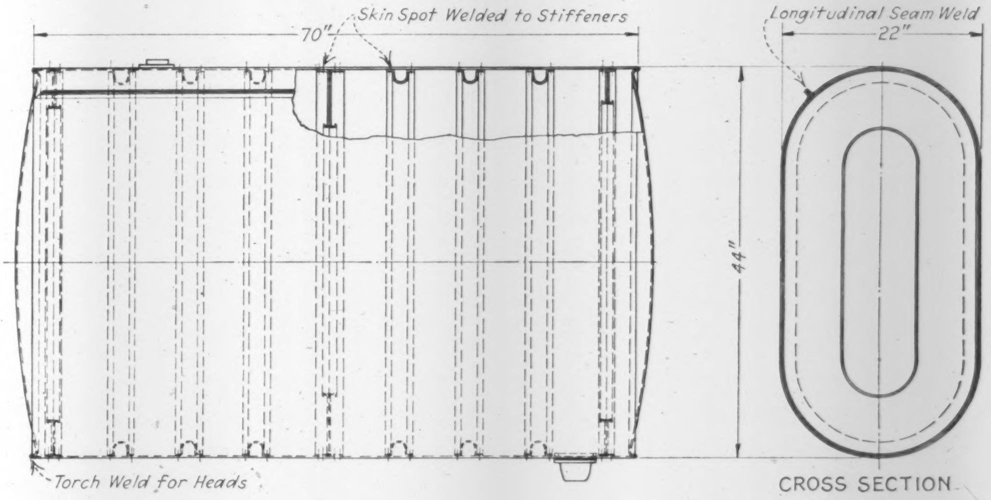


FIG. 5 THE TANK SHOWN IN FIG. 4 AFTER REDESIGNING TO USE SPOT-WELDED CONSTRUCTION
(Many of the original baffles have been replaced by U-shaped stiffener sections which make the inside of the tank more accessible for welding the stiffener flanges to the skin sheet.)

Attempts to use the single-pan type baffle, without excessive weight, in the large tank illustrated in Fig. 5 were unsuccessful, owing to fatigue failures of the baffles in the corner between the web and the flange or at the spot welds which fasten the flange to the skin sheet. Crowning the baffles was tried in an effort to stiffen them to reduce the vibration, and although crowned baffles seemed stiff, nevertheless, they failed in fatigue when the tank was subjected to the vibration test. Tying the webs of all the baffles together was also ineffective. As none of these schemes was satisfactory, the single-pan type baffle was given up in favor of the U-shaped stiffeners in this large tank.

The single-pan type baffle was used successfully in the tank illustrated in Fig. 6 without any stiffener to prevent vibration of the web. This was possible largely because the baffles were relatively small. The tanks in question were long with respect to the cross section and had to be made to close tolerances for size and shape. Problems of spot-welded construction were solved satisfactorily in this case with single-pan type baffles.

Fig. 7 shows a single-pan type baffle which was used successfully in a tank of intermediate size. In this case, the corner of the pan was stiffened or reinforced by an angle section formed from sheet. The baffle web was also stiffened by formed sections that were spot-welded to it. Such stiffeners are not generally recommended, however, since vibration may cause them to break loose, because of the difficulty of fastening the ends adequately to prevent high stress concentrations. Furthermore, these stiffeners tend to complicate the construction. In some instances stiffening baffle webs of this type by embossed beads or ribs extending from one side to the other has been found better.

FASTENING THE HEAD TO THE SKIN SHEET

Some fuel tanks are made with baffles running in two directions, intersecting each other. Such a "honeycomb" construction is not readily accessible for spot welding. As originally designed for riveted construction, the tank illustrated in Fig. 6 could not be assembled by spot welding. It had a vertical baffle running the full length of the tank and intersecting the cross baffles. As will be noted in this illustration, cross baffles were retained, using the single-pan type, but instead of a longitudinal baffle, the shell was stiffened by small T-sections spot-welded to the outside of the tank. This design lends itself economically to spot-welded construction and is recommended for tanks in which the external stiffener is not objectionable or does not interfere with the tank supports or other structural members adjacent to the tank.

The head of the tank shown in Fig. 3 was fastened to the skin sheet by seam welding. This method can be employed in some instances when the extended flange is not objectionable. Many tanks are shaped so that the flange cannot be seam-welded because of inability to traverse the flange with the welder wheels. Torch welding has generally been found better for fastening the heads to the skin sheet, using a connection such as that illustrated in Fig. 5. This method is adaptable to many different shapes of tank and makes possible the assembly of the entire tank structure from the outside, working through the open ends of the shell, which are closed on the final operation.

Crowned heads should be made the same thickness as the tank side wall and should be crowned out for a distance equal to about one eighth of that across the head or more. Heads made with less crown may require stiffeners to prevent excessive vibration. Head stiffeners similar to the baffle web stiffeners shown in Fig. 7, spot-welded across the inside of the head, have been used satisfactorily. With a sufficient crown in the head, such stiffeners are not generally necessary. A little more crown or an increase in metal thickness or a combination of both is generally preferable to the use of stiffeners across a tank head.

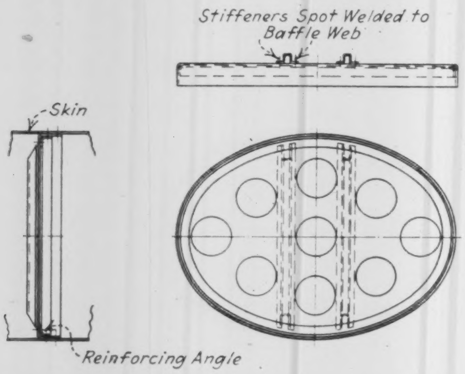


FIG. 7 ANOTHER BAFFLE OF THE SINGLE-PAN TYPE

(An angle section formed from sheet metal is used to reinforce the corner of the pan and the web is also reinforced by formed stiffeners.)

Longitudinal welds in the skin sheets may be either torch- or seam-welded. The latter has been used in a number of different tanks and is generally recommended where the outstanding flange is not objectionable. This flange must be at least $^5/_8$ in. high to allow ample room for the seam weld with proper edge distance for the thicknesses of sheet generally used in fuel tanks. The distance from the center of the seam to the edge should be at least four times the thickness of the sheet. In some instances, advantage may be taken of the outstanding seam-welded flange by locating it so that it will serve as a stiffener section across a flat side.

THICKNESSES OF MATERIAL THAT CAN BE WELDED

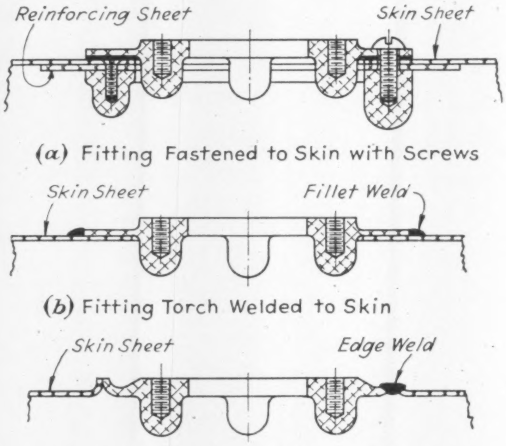
Spot and seam welding can be used satisfactorily for joining together aluminum sheets ranging from about 0.015 up to 0.125 in. in thickness, with the equipment now available. The range depends somewhat upon the number of sheets to be joined together and the thicknesses of the various sheets, if they are not all the same. This method is therefore applicable to the gages used for practically all fuel tanks. Best results are obtained when the sheets do not differ greatly in thickness, but a difference of one or two B. & S. gage numbers is not significant.

Experience indicates that the thickness of material used for the baffle and stiffener flanges should not be more than that of the skin sheet and preferably one or two gage numbers less. In the vibration tests of fuel tanks, spot-weld failures between the baffle structure and the skin sheet always occurred in the baffle or stiffener flange and not in the skin sheet, if the baffle was not made thicker than the skin. This relation of thicknesses is recommended as a safeguard against leaks in a tank which may be subjected to unusually severe service conditions.

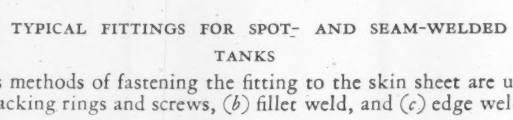
As in the case of rivet spacing, the spacing of spot welds depends on the general design and no definite rule can be given. Experience indicates that spot welds should be three to four times the number of rivets needed for a similar structure. Spot-weld spacing of $^3/_4$ to 1 in. is common in fuel tanks and should not be less than $^5/_8$ in. The distance from the center of the spot weld to the edge of the sheet should be at least four times the thickness of the sheet.

Spot- and seam-welding equipment as used for other metals is, in general, not suitable for best results in welding aluminum. Because of the comparatively high electrical and thermal conductivities of aluminum and its alloys, equipment should be used in which the time of the current, its magnitude, and the pressure between the electrodes are carefully controlled. For seam welding, equipment with full electronic timing is essential; it is also desirable for spot welding, although good spot-welding results can also be obtained with vacuum-tube or mechanically controlled contactors for some classes of work. With proper equipment, consistently good spot and seam welds will result, with a remarkably small percentage of defective spots.

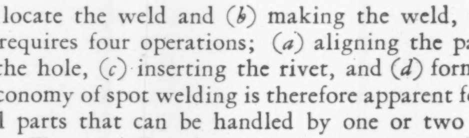
Spot welding requires only two operations; (*a*) aligning the parts to locate the weld and (*b*) making the weld, whereas riveting requires four operations; (*a*) aligning the parts, (*b*) drilling the hole, (*c*) inserting the rivet, and (*d*) forming the head. Economy of spot welding is therefore apparent for welding small parts that can be handled by one or two men as shown in Fig. 9. For large tank structures, mechanical-handling equipment becomes necessary; otherwise, the number of men required may result in excessive costs.



(*a*) Fitting Fastened to Skin with Screws



(*b*) Fitting Torch Welded to Skin



(*c*) Fitting Torch Welded to Skin

FIG. 8 TYPICAL FITTINGS FOR SPOT- AND SEAM-WELDED FUEL TANKS

(Various methods of fastening the fitting to the skin sheet are used as (*a*) backing rings and screws, (*b*) fillet weld, and (*c*) edge weld.)

In some instances where a row of spot welds is used in a structure, the seam-welding machine is well-suited for greater operating economy. In this case, the machine is timed to make an intermittent instead of a continuous seam. Timing can be adjusted to give any desired spacing of the spots which is done automatically, thus eliminating the necessity of first marking off the spot spacing on the work. Intermittent spots can also be made more rapidly than is possible when the operation for making individual spots with a spot-welding machine is repeated.

TABLE 1 TYPICAL MECHANICAL PROPERTIES OF TWO ALUMINUM ALLOYS

	Tension			
Alloy and temper	Ultimate strength, lb per sq in.	Yield strength (set = 0.2 %), lb per sq in.	Elongation in 2 in.,[a] %	Fatigue endurance limit, lb per sq in.
3*S*—O	16000	6000	30	7000
3*S*—$^1/_4$*H*	18000	15000	10	8000
3*S*—$^1/_2$*H*	21000	18000	8	9000
52*S*—O	29000	14000	25	17000
52*S*—$^1/_4$*H*	34000	26000	12	18000
52*S*—$^1/_2$*H*	37000	29000	10	19000

[a] Specimen $^1/_{16}$ in. thick.

COMPARISON OF TWO ALLOYS USED FOR TANKS

Table 1 lists the mechanical properties of two aluminum alloys that are well-suited for fuel tanks where spot and seam welding are employed. Alloy 3*S* has been used for many years for tanks that are fabricated by riveting and torch welding, whereas alloy 52*S* is more recent and its use has been confined mostly to spot- and seam-welded tanks. As will be noted, alloy 52*S* has higher mechanical properties, and its endurance limit is considerably better than that of alloy 3*S*. With its higher tensile and yield strengths, a tank of alloy 52*S* will be stronger for carrying internal pressure and for supporting the weight of liquid. This alloy should also be better for resisting vibration because of its higher endurance limit. According to vibration tests of fuel tanks and observations of tanks in service, however, no evidence is available to indicate any appreciable difference between these two alloys for tanks subjected to vibration. This evidence is based on tanks that have relatively flat surfaces, where vibration is especially apt to occur. The explanation seems to be that tanks of 3*S* alloy probably bulge a little more from internal pressure because of the lower yield strength of this material, thus crowning the flat surfaces to a greater degree than will occur in the case of 52*S*. This increased crown, although not enough to be objectionable to the size and general appearance of the tank, evidently is sufficient to stiffen the surfaces and reduce the tendency toward vibration in the case of 3*S* tanks. Generally speaking, 3*S* or 52*S* alloys are about equally satisfactory for spot- and seam-welded tanks.

Fittings for spot- and seam-welded fuel tanks may be fastened to the skin sheet by torch welding or by backing rings and screws, as in Fig. 8(*a*). The fitting illustrated in Fig. 8(*b*), in which the casting is fillet-welded to the skin sheet, has been used extensively with satisfactory results in both 3*S* and 52*S* tanks and it is especially recommended for tanks of the former alloy. Fittings of the type shown in Fig. 8(*c*), with an edge weld, are preferred, however, for 52*S* alloy tanks as they provide a better welding condition. Fittings that are welded to the skin are best if made of the aluminum casting alloy containing 5 per cent of silicon, and welding wire of the same composition should be used. A heat-treated alloy, such as that containing 4 per cent of copper, is preferred for fittings that are fastened with screws.

In the foregoing discussion no definite conclusions have been reached as to a preferred method of construction for all tanks. Each tank is a problem in itself and no two can be handled alike, because of the many variables that enter into each problem. Different baffle and stiffener constructions have been discussed to show their desirable and undesirable characteristics and to point out how they have been employed in different tanks. Most of the discussion is based on experience with aircraft tanks, but it might properly apply to other tanks also.

Experience points out the desirability of simplicity in construction. This not only makes a tank more suitable for spot and seam welding but also results in fewer parts that may lead to difficulties from vibration under unusually severe service conditions. In fact, simplicity in some tanks may well be carried to the point where greater serviceability and economy of weight and cost will result by reducing stiffeners and baffles to the minimum and using thicker material in the tank shell.

No attempt has been made to set forth the principles of design for the determination of the size and spacing of the stiffeners and thickness of the skin or to give analytical derivations for the rules suggested. Such a treatment might properly come in a separate paper.

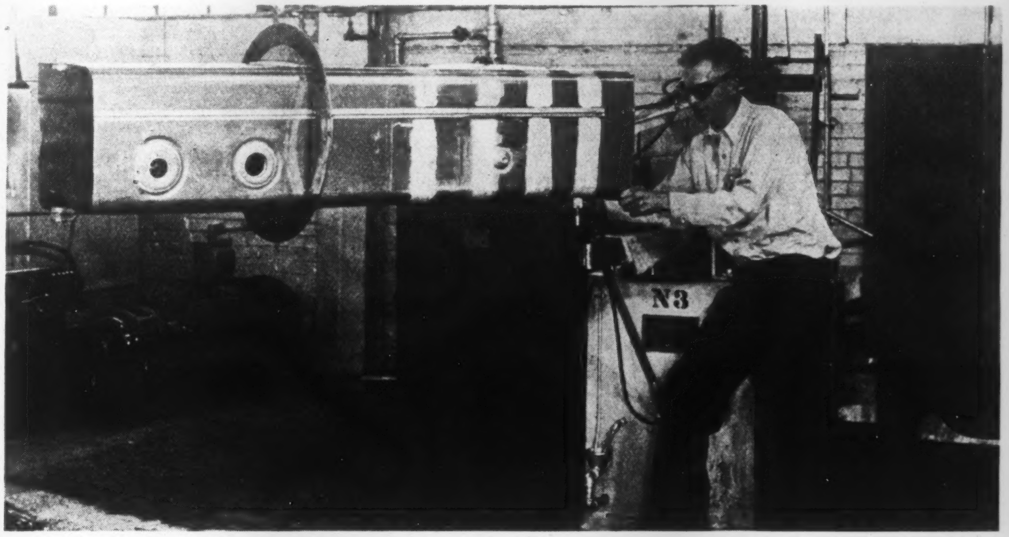


FIG. 9 SUITABLE HANDLING EQUIPMENT ENABLES ONE MAN TO SPOT-WELD A FUEL TANK

TECHNOLOGICAL PLANNING

By RALPH E. FREEMAN

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THOUGH the influence of invention may be so great as to be immeasurable, as in the case of gunpowder or the printing press, there is usually opportunity to anticipate its impact upon society since it never comes instantaneously without signals. For invention is a process and there are faint beginnings, development, diffusion, and social influences, occurring in sequence, all of which require time. From the early origins of an invention to its social effects the time interval averages about thirty years. Such, in brief, is the case for planning to meet the new situations caused by technical change. The case was presented in the report of the National Resources Committee on Technological Trends and National Policy.[1] If legislators, governors, and presidents could have foreseen the development of the automobile, the airplane, the motion picture, rayon, and the radio and could have anticipated their influence on society and the changes precipitated, they would have been in a much better position than they were to direct the policy of the state. "Highways are too narrow. The metropolitan area could have been planned better; much crime could have been prevented. Industries could have been located to better advantage. The growing inadequacy of small local governments could have been more clearly foreseen, and the transfer of some of their functions to a more capable centralized government would have been facilitated."

REPORT RECOMMENDS CREATION OF NATIONAL RESOURCES BOARD

The report recommends the creation of a National Resources Board as a permanent planning agency to function as coordinator for the many special planning boards which now exist in 47 states, 400 counties, and 1100 cities. Under this controlling authority a federal committee should be responsible for keeping abreast of technological development and for predicting changes that may affect our national life. Independent science committees should be set up to undertake special studies. These committees should concentrate their initial efforts on the mechanical cotton picker, air-conditioning equipment, plastics, the photoelectric cell, artificial cotton, and woolenlike fabrics made from cellulose, synthetic rubber, prefabricated houses, television, the automobile trailer, gasoline produced from coal, steep-flight aircraft, and tray agriculture.

To emphasize the need of technological planning, the report shows the kinds of new inventions which may affect future living and working conditions in America. A large group of scientists and engineers present a survey of many of the great fields of technology and applied science—agriculture, mining, transportation, communication, the construction industries, the metallurgical and chemical industries, power production, and electrical manufacturing. These separate studies make up part 3 which constitutes nearly 70 per cent of the whole report; and, apart from any planning implications, they provide an abundance of interesting information for readers who wish to obtain a survey of current technical trends in our major industries.

OBSTACLES IN WAY OF USEFUL PLANNING

There are four serious obstacles in the way of useful planning in this field: The first is the difficulty of foreseeing the invention; the second is the difficulty of forecasting its social consequences; the third is the difficulty of determining the action to be taken; and the fourth is the difficulty of taking the necessary action. The first of these obstacles is not insurmountable if the invention is slow in its development. But the second is more formidable. H. E. Howe, discussing the chemical industries, writes: "It is most difficult to forecast what the social implications may be as we go forward with chemical research and the applications of its results. Sir James Irvine once said that by the modesty of their predictions do scientists justify faith in their work. Notwithstanding carefully planned investigation, unexpected by-products of such activity may be the very ones that will have the most far-reaching effect. When Maxwell, Hertz, and others began their investigation of short wave lengths, no one could have imagined the variety of almost vital applications to which X-rays are now put. There are many such examples which make the scientist hesitate to put on the robes of the prophet."

But even when both the invention and its major effects can be anticipated, the questions as to what should be done and how to do it remain unanswered. The authors of the section on agriculture consider that the introduction of a successful mechanical cotton picker would sharply reduce the greatest single source of employment for women and child labor in America and deal a mortal blow to the tenant farmers and croppers of the cotton belt. The authors imply that if the length of the period of introduction is great enough, individuals displaced by this labor-saving device might be absorbed elsewhere with only limited shock. In other words little central planning would be required. They suggest that the slack labor supply would be taken up by diversification of southern agriculture, by a movement of northern industries into the South, or by the rise of new industries. In other words, the readjustments would be accomplished by the rather slow operation of economic forces.

But suppose the mechanical cotton picker is rapidly introduced and readjustments have to be made quickly, if great social disturbance is to be avoided. The central planning board would then be called upon for immediate action. Would it undertake to stimulate diversification of crops in the South? If so, how; and what means would be used to dispose of these crops? Would the board encourage the immigration of industries from other districts, using subsidies or taxation or freight-rate adjustments? What would become of the capital and labor now invested in these industries? Perhaps the planning board would decide to prevent the necessity for such adjustments by prolonging the introduction of the mechanical picker. But this policy might result in holding production costs above the level obtainable in other countries and thus deprive the industry of its foreign markets.

(*Continued on page 942*)

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[1] Report of the Subcommittee on Technology to the National Resources Committee, United States Government Printing Office, Washington, D. C., 1937, p. 388.

One of a series of reviews of current economic literature affecting engineering prepared by members of the department of economics and social science, Massachusetts Institute of Technology, at the request of the Management Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Progress in RAILROAD MECHANICAL ENGINEERING *in* 1937

Part I—High-Speed Service and Steam-Locomotive Developments

RAILROADS are currently benefiting from the gradual disappearance of the economic world crisis. Traffic development, generally speaking, is keeping pace with that of other transport agencies. Study of fundamental traffic problems is no longer handicapped by the distorted picture of recent years, and greater safety of judgment will also assist the railway mechanical departments in shaping equipment policies. Traffic receipts for the Class I railroads of this country rose 10.0 per cent in the first seven months of 1937 as compared with last year, 10.5 per cent from freight and 9.5 per cent from passengers, while the rise in volume was about twice as great. Abroad, Germany reported a similar increase in receipts, supplementing a steady rise during several years, and German weekly car loadings in July reached 804,000. Austria and Switzerland, which had not participated in the upward movement of 1936, are now experiencing a rise of over 15 and 16 per cent, respectively, with a progressive tendency, and a current gain in freight volume considerably in excess of 20 per cent. French traffic shows a moderate rise, in spite of social disturbances, but the cost increases created by the latter have more than offset the gain there. The United States appears to be the only other country where rising costs, due preponderantly to social developments, have seriously affected net revenues, and even wiped out the slackening rise in gross since July. Great Britain's and the Scandinavian railroads present a cheerful picture; the percentage increases have been small, but receipts are close to those of 1929. High-class passenger service is also substantially on the increase throughout the world; the International Sleeping Car Company reports a 20 per cent rise in gross income in the first half of 1937, and Pullman transportation in the United States brought 13.8 per cent more than last year.

A striking example of the importance of long-distance passenger transportation is offered by the Christmas traffic of the Paris-Lyon-Méditerranée Railway on Dec. 23, 1936, when within 5 hr after 7:30 p.m., 51 fast passenger trains left Paris, almost all scheduled over more than 400 miles, and 47 of them traveled over 196 miles at intervals of 6 to 7 min (1).[1] The railroads have no competitors in such mass movements, and improvement of their ability to serve the public should be the concern of government and business.

HIGH-SPEED SERVICES INCREASE THROUGHOUT THE WORLD

Definite acceptance of the high-speed trend in both passenger and freight services by the railroads all over the world is currently demonstrated by a broadening of such services without spectacular new top-speed records. The trend set by especially developed vehicles must now be gradually followed also by conventional equipment, and efforts are manifest everywhere.

Among the noticeable developments in this country is the inauguration of the following train services. On March 21, the new *Daylight* streamlined steam trains went into service on the Southern Pacific between San Francisco and Los Angeles, covering 471 miles of curved coast route in $9^3/_4$ hr each way at a commercial speed of 48.4 mph with five intermediate stops, while other trains take at least 12 hr at an average speed of 39.2 mph, and the earlier *Daylight* train of 1932 took $12^1/_2$ hr (2). Normal equipment consists of 12 stainless-steel cars and a 4–8–4 type steam locomotive.[2] The Santa Fe's weekly *Super Chief* remained on its $39^3/_4$-hr schedule from Chicago to Los Angeles and vice versa, covering 2228 miles at an average speed of 56.1 mph, but on May 18 nine new stainless-steel cars were put in regular service to replace the former standard cars, as well as an improved Diesel-electric locomotive rated at the same horsepower as the one of 1936. On a demonstration run the day before, the distance was covered in 36 hr 49 min, including 17 stops, at an average of 60.5 mph, thus beating the previous record of 1934, made between these points by the Union Pacific M-10001 Diesel train, of 58.8 mph. *The Chief*, the Santa Fe's daily steam train on this route has again been speeded up slightly, to 50 hr 44 min westbound or 44.0 mph average speed and 49 hr eastbound or 45.5 mph average speed, the latter figure representing a $7^1/_2$-hr cut from 1933. A comparable steam schedule has been established between Chicago and San Francisco over the Union Pacific by inauguration of the eight-car *Forty Niner* on July 8, operating five times a month, thus alternating with the Diesel train *City of San Francisco*. An average of 44.6 mph is reached on the eastbound run of 49 hr duration for 2260 miles, while the westbound timing is 50 hr 42 min. This represents a notable improvement over last year's fastest steam train, the *Overland Limited*, which made the run in 60 hr 47 min westbound and maintained an average speed of 37.6 mph and 58 hr 35 min eastbound or 39.1 mph average speed. The *City of San Francisco* has been so successful that a new train with 14 revenue cars, instead of the present 9, is under construction. The *City of Denver* had 12 min cut from its eastbound run where it now averages 67.1 mph over the 1048 miles, proving the practicability of this remarkable service. One of the new *Rocket* Diesel streamliners of the Rock Island Lines was placed in service on Sept. 25 between Chicago and Des Moines, Iowa, covering 358 miles, on a 6-hr schedule.

In the eastern territory, a further speeding up of the New York Central's *20th Century Limited*, which now averages 58.2 mph between New York and Chicago, and of the Pennsylvania's *Broadway Limited*, which averages 55.0 mph over the shorter route with the same running time of $16^1/_2$ hr, is contemplated in 1938, when new equipment for these trains will be ready. In nonextra-fare service, the fastest commercial speed, that of the New York Central's westbound *Commodore Vanderbilt*, remains this year at 56.0 mph. The fastest electric train, the

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[1] Numbers in parentheses refer to the Bibliography at the end of this report.

Report prepared by Railroad Division, Committee RR6, Survey, A. Giesl-Gieslingen, chairman, for presentation at the Annual Meeting, New York, N. Y., Dec. 6–10, 1937, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[2] Equipment details of this and other trains will be found under appropriate headings elsewhere in the report.

Pennsylvania's *Congressional Limited*, between New York and Washington, had its schedule cut by 5 min to 215 min for 226 miles, averaging 63.1 mph with six intermediate stops.

In Europe, the London & North Eastern inaugurated the *Coronation*, a nine-car steam train, between London and Edinburgh, covering the 392 miles at 65.5 mph (3, 4). In Italy, electric high-speed service at 63.0 mph has been established between Bologna and Naples, 386.5 miles, including stops at Florence and Rome, cutting one-third off last year's transit time. The Berlin-Rome weekly winter service, traversing the Alps at the Gotthard in Switzerland, covers 1222 miles in $26^1/_4$ hr at 46.6 mph. Daily service is available over the shorter route through the Austrian Tyrol using streamlined Diesel trains in Germany and electric streamliners in Italy, at about the same average speed of 46.3 mph over 1031 miles. European time-table conferences demonstrate the general desire to expedite passenger traffic by numerous biannual improvements of the complicated international train network.

The four-car steam train of the Paris-Lyon-Méditerranée between Paris and Marseilles has been accelerated by 20 min, cutting the transit time to 9 hr for the 536 miles of largely difficult route and five intermediate stops which represents an average speed of 59.6 mph. The well-known *Sud Express* of the Paris-Orléans-Midi remained unchanged this year, at 63.7 mph over the 365 miles from Paris to Bordeaux, with four stops, and so have the German high-speed trains discussed last year.

Line revisions are becoming more important as a means of reducing speed restrictions and consequently improving not only the schedule but also the economics of high-speed service (5). In this country, large programs have been and are being carried out on the Santa Fe between Chicago and Los Angeles (6), and by the Southern Pacific on its Coast Line, and all railroads introducing high-speed trains are active in this direction. Maximum curvatures of 1 deg 30 min with $4^1/_2$ in. of superelevation have been found desirable and are negotiated at 85 mph. To insure comfortable riding through sharper curves with 6-in. maximum superelevation, speeds are restricted so as to correspond to not more than 3 in. of unbalanced elevation, which means lateral forces, measured in the plane of the track of about 5 per cent of gravity. New rules for high-speed track now established in Germany closely approximate this condition, but 6-in. superelevation is used also for curves of 1.35 deg, permitting a speed of 100 mph. In Great Britain, the route of the *Coronation Scot* between London and Glasgow has been improved by relocating over 100 curves with an aggregate length of 60 miles. The Austrian Federal Railways now avoid any intervening short tangent track between successive curves wherever possible, because immediate joining of spirals results in smoother running. A few railroads are introducing switches for high speed over the bifurcation, those of the German State Railways as exhibited at Düsseldorf permitting 75 mph.

In freight service, the container is gaining ground also in Europe where new standardization rules have just been established (7). For high-class merchandise, the self-propelled freight rail car is in the experimental stage in Great Britain (8) and on the German State Railways; the latter favors the light, fast steam freight trains which are now successfully established after 10 years of service (9). This problem is due for wider attention because handling express shipments in main-line passenger trains causes delays at station stops which are becoming increasingly objectionable.

Railroad construction in this country already showed some signs of an upturn in 1936, when 93 miles of new line were built, 42 of which were on the Norfolk & Western for coal traffic (10). On Feb. 1 of this year, the Santa Fe opened a new 112-mile line (11), shortening the connection between Denver, Colo., and Amarillo, Tex., by 374 miles, the largest project since 1931. The outstanding event, abroad, was the opening, on May 4, of the northern leg of the Trans-Iran Railroad, from Teheran to the Caspian Sea, a distance of 286 miles, which after extension to the Persian Gulf in 1939 will be 870 miles long. The part of the line just opened, which is through most difficult rugged mountain terrain, including 75 tunnels aggregating 13 miles in length and a similar number of bridge spans, was built by the Austrian engineer von Rabciewicz according to plans of the Swedish engineer H. Hacklin. The contract is held by a Swedish group. This bold undertaking is a major proof of the modern railroad's vitality. Of the current Yugoslavian construction program, 251 miles will be put in service during the fiscal year 1937–1938. The last link of an 806-mile Swedish route to the northern forest areas, under construction since 1907, was completed during the summer. A 76-mile line of difficult characteristics was opened in Sicily. Russian railroad building advances less speedily than planned, but 1860 miles of new line have been put in service since 1933. Work on five major programs, totaling 1000 miles, has been started in Mexico (12).

ENERGY PROBLEMS

Railroads are confronted with a rapidly widening choice in the motive-power field. High-powered Diesel locomotives have become a reality on several of the world's railroads, and, while they may justly be called experimental in an economic sense, their rapid appearance is contrary to the expectations of many who recently doubted the expansion of the Diesel beyond the switching and lightweight field. Multiple operation of Diesel rail cars with only one engineer is being introduced in several countries, even where the transmission is mechanical. Electric traction, however, appears in a new light as the tendencies of installing high horsepower per ton are gaining economic justification to reduce the spread between top and commercial speeds, particularly on grades and with frequent stops and slowdowns. Today, our fastest United States Diesel streamliners fall behind a low-priced automobile when the grade approaches 1 per cent. In Austria, Germany, Italy, and Switzerland, recent electric main-line cars and multiple-unit trains are capable of continuously climbing a $2^1/_2$-per cent grade at over 60 and even 70 mph, as actually demonstrated. Automobile competition is forcing new conceptions of climbing speeds and power requirements upon the railroads. Specialized forms of steam and Diesel traction can fulfill many of these, but the straight electric train is least subject to limitations.

Selecting motive power imposes a growing responsibility and should be met by intensified research and exchange of experience. Considering developments in new steam and Diesel power and changes visualized in electric traction by using the commercial frequency of 50 or 60 cycles as just introduced in Germany (15, 16), the task of selection must be made easier by greatly accelerated amortization of equipment. To make this possible, maximum availability of motive power must be secured by suitable design and maintenance practices, and all talents of organization must be exerted to arrange for maximum use of equipment. This, too, calls for intense cooperation.

Fuel-oil supply and prices are likely to become of fundamental importance in future years. A survey recently published by the German Government Institute for the Study of Business Trends (13) finds, on the basis of the best available estimates, that the world's coal deposits will be good for 3730 yr if the output remains at the 1935 level, or for 595 yr if it rises 0.5 per cent per year, but the known oil supply of 4400 million tons may be exhausted after 18 yr. Although new supplies will probably be found, an upward price trend is likely in due course. The cost of manufacturing oil out of coal by hydrating as introduced in Germany is at present a multiple of natural oil prices. According to a report by the Australian Government (14), the cost of synthetic gasoline manufactured in England would now exceed the import price by 150 to 200 per cent, while cost of manufacture in Australia would be still considerably higher. In this light, further development of steam motive power, which can be operated on either coal or oil, is of additional interest.

For similar reasons, reinforced by the policy of national self-sufficiency, German manufacturers continue working on the development of the pulverized-coal internal-combustion engine. A notable success has recently been achieved by Schichau at Elbing in combating the hitherto excessive cylinder wear. The wear is transferred to the piston by using outside "bushing rings," and the rate of wear with coal containing 7 per cent of ash is now from 0.002 to 0.005 in. per 100 hr without resort to expensive measures, or a small fraction of the figures of several years ago (17). This illustrates the efforts of making the internal-combustion engine suitable for solid fuel.

GENERAL DESIGN PROBLEMS

While details will be discussed under their respective headings, many aspects of design are now common to all forms of motive power and rolling stock, and broadening vision of engineers is leading to more universal approach. Since the importance of maximum availability is now generally recognized, its consideration plays a leading part in design. It is closely coupled with wear reduction in a broad sense and with accessibility for repairs. Answers received from 18 leading railroad officials here and abroad place the problems of lubrication first on the list. Roller bearings are regarded as a major factor; induced by competition from these, improved lubrication systems are beginning to bring success. Reduction of wear and failures is in most cases synonymous with that of forces; with high speeds, dynamic forces preponderate in the design of all types of vehicle, and their reduction is a universal problem. Scientific design can often accomplish results more cheaply and safely than special materials. For instance, Ganz at Budapest, Hungary, has recently departed from the universal practice of providing a stiff U-section for the connecting-rod ends of its high-speed Diesels. In shaping the heads so that the pins are enveloped by an elastic band, eliminating rigidity where it is not needed, the weight was reduced by one-third and manufacture became cheaper (18). Much can be accomplished in reducing forces and weights by studying where rigidity is required and where there should be resiliency. In other words, dynamics of design are coming to the fore, but many mistakes are still being perpetuated in this field. In car and truck frame design, fabrication by welding permits of choosing flexibility where castings will not give any such freedom (25). Investigating design from the standpoint of related industries, such as automotive engineering, is highly inspiring (26, 27).

The aforementioned replies indicated also the serious limitations imposed upon availability by tire wear. While more enduring materials for tires are being sought, the key to this problem is undoubtedly design. The large field opened up by this question is common to all railroad vehicles. It embraces the broad problems of reaction between wheels and rail and of parasitic movements. Passenger cars are affected by tire wear to an even greater extent than multiple-axle locomotives. Some much-needed research is now being conducted on a larger scale. On the Santa Fe, where pioneer tests of this nature with steam locomotives were carried out years ago, recent investigations on wheel loads and rail failures by the American Railway Engineering Association were made under Professor Moore (19). Improvements as applied to existing locomotives are discussed by G. M. Magee (20). While hammer-blow and other effects inherent to reciprocating steam locomotives are simple to deal with, rhythmic oscillations of vehicles having only rotating masses are an intricate subject which has already caused much expense through faulty design as a result of wanting information. Here again, cooperation of the permanent-way engineer is necessary for analysis, as Dr. A. N. Talbot points out in his recent report (21). Advanced methods of studying track depression and rail stresses are being used in Poland, with photographic recording, and have been published in much detail (22).

In establishing permissible speeds through curves, railroads all over the world have found the passenger's comfort to be the limiting factor and have arrived at closely corresponding figures (24) permitting unbalanced lateral forces of about 5 per cent of gravity, as in American practice. Since speeds could be much higher from a safety standpoint, lowering of the center of gravity should not receive undue interpretation.

The introduction of long rails, of 100 to 200 ft, is spreading abroad. In rail welding, the Delaware & Hudson is leading with 30 miles of track welded in 1937 into continuous lengths up to nearly 7000 ft which are held by GEO rail fastenings (23). Extension of this practice would do away with the rhythmic induction of vertical and rolling oscillations; however, avoiding a tendency of the vehicle to set up progressive oscillations of its own will then be even more important. Springs, which now are also a major source of failures, deserve particular attention.

Finally, availability of vehicles is furthered by preventive maintenance before failure occurs. While this is a problem of organization, ease of dismantling, exchange, and standardization of parts is in the designer's hands. Exchangeability of driving units in electric and internal-combustion motive power has thus far not been matched by the steam locomotive, but efforts have been initiated, such as individual-axle drive.

The example of France, where record productivity in new developments has been achieved in recent years, vividly demomstrates that, with due regard for the advantages of centralized research, a successful search for new solutions demands that broad liberties be given to the ingenuity of individuals (27).

AMERICAN AND CANADIAN STEAM-LOCOMOTIVE DESIGN

Domestic steam-locomotive orders totaled 166 in the first three-quarters of 1937, most of them being given early in the year. Canadian orders reached 50. The large majority have four pairs of drivers, the minimum is three, and capacities probably exceed 4000 ihp in most cases. The light locomotive is again completely absent. This applies also to the considerable numbers ordered at the end of 1936.

A third lot of 50 of the successful Hudson-type engine of the New York Central, which is illustrated in Fig. 1, is currently being received from the American Locomotive Company, raising the total number on the system to 275. Principal distinctions from the earlier orders include lightweight reciprocating and revolving parts, with a reduction of dynamic augment for front and rear drivers at 79 mph, "diameter speed," from 11,950 to 5900 lb or 18 per cent of the wheel load and for the main drivers from 9000 to 4400 lb. The boiler, designed for 275-lb pressure, 50 lb more than previously, received a combustion chamber 42 in. long and increased steam space by adding 4 in. in diameter to the rear and about 2 in. to the front boiler course. Thus, although nickel steel is now used for the shell, the boiler weighs 15,800 lb more, all but 1400 lb of which

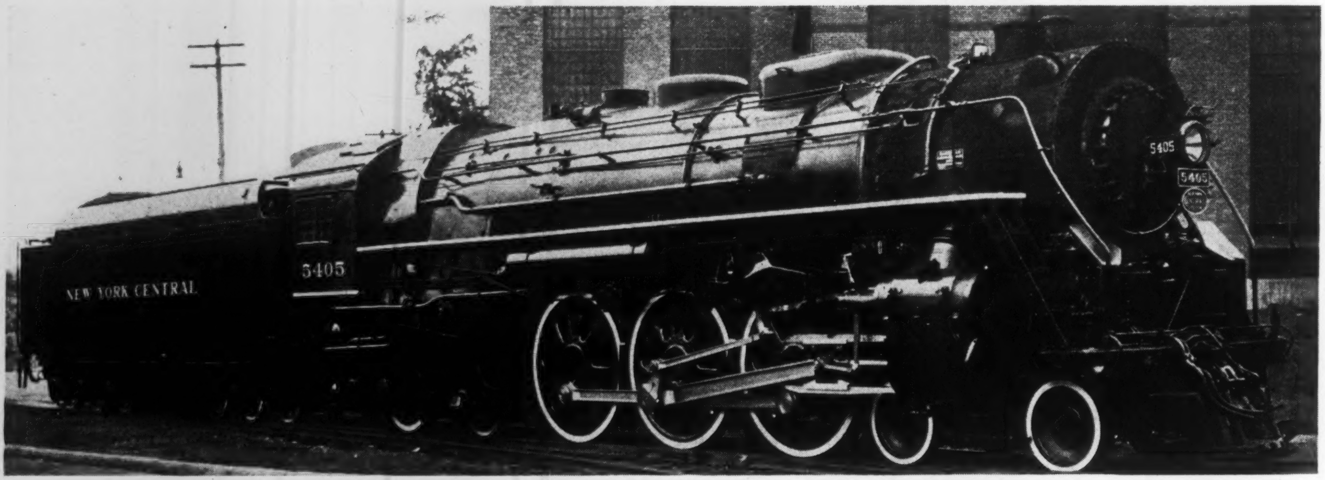

FIG. 1 NEW YORK CENTRAL J-3 HUDSON-TYPE LOCOMOTIVE

have been saved elsewhere by careful redesign of details so that the engine weight is 360,000 lb. Aluminum cabs and running boards on 30 engines are expected to save these remaining 1400 lb also. Weight on drivers has been raised by 5300 lb to 196,000 lb, tractive effort with $22^1/_2 \times 29$-in. cylinders is 43,500 lb or 2.6 per cent more, and the booster, which is 11 per cent stronger than before, adds 12,100 lb or 28 per cent to the main engine. In keeping with specific high-speed service over preponderantly level track, the factor of adhesion is high, namely, 4.5. All engine axles are equipped with Timken roller bearings, and five locomotives will receive Timken roller-bearing rods. Rubber draft gears are provided, and the last ten locomotives, which are to be streamlined for handling the new *20th Century*, will receive tight-lock couplers. The new streamlined engines will weigh 362,000 lb, or 8000 lb less than the *Commodore Vanderbilt*. The new tenders have equal water capacity, 14,000 gal, but coal space for 30 tons instead of 28 and installation of a coal pusher increased the loaded weight by 12,600 lb to 314,300 lb. Dynamometer tests are now in progress.

Of this year's other Hudson types, the ten Baldwin-built streamliners for the New Haven, Fig. 2, are outstanding. They have been developed after careful tests of power requirements with a view to replacing the Pacifics of 1916 which hitherto handled the heavy through trains but were becoming inadequate (28, 29). In general dimensions and weights, they closely correspond to the New York Central engines, but the boiler is somewhat smaller, having 3815 sq ft of evaporative surface with relatively short tubes of 18 ft and 77.1 sq ft of grate area. They carry 285-lb boiler pressure and develop 44,000 lb rated tractive force in 22 × 30-in. cylinders with 80-in. drivers. SKF and Timken roller bearings are applied to all axles. The tenders carry 18,000 gal of water in riveted tanks and 16 tons of coal and weigh 332,000 lb.

The most powerful Hudson-type locomotives under construction are probably the nine ordered from the American Locomotive Company by the Chicago & Northwestern. Their tractive effort will be 55,000-lb with 300-lb boiler pressure, 25 × 29-in. cylinders, and 84-in. drivers. Adhesive weight is expected to be 216,000 lb and the grate area is 90 sq ft. The Lackawanna is having five Hudson-type engines built with the lowest factor of adhesion of 3.75 for economical service in partly mountainous territory. The Burlington equipped a standard Hudson-type locomotive with a streamlined stainless-steel cover (30) and roller-bearing rods, which is intended for relief duty on the *Denver Zephyr* and other high-speed runs up to 100 mph.

The Santa Fe is carrying out an interesting motive-power program through Baldwin, involving several each of 4–6–4, 4–8–4, and 2–10–4 locomotives to cover varying requirements of heavy passenger and freight service. Driving-wheel diameters will be 84, 80, and 74 in., respectively; boiler pressures range from 300 to 310 lb; and the tractive efforts are 49,300, 66,000, and 93,000 lb, the latter two having 60 per cent limited cutoff. The passenger locomotives, one of each will be streamlined, are to be equipped with roller bearings and are expected to handle runs of 992 and 1235 miles, respectively. The 2–10–4 type freight locomotives have as their forerunner engine No. 5000 of 1930 which had been subjected to extensive tests (33). Piston thrust, which had been 212,000 lb on No. 5000, has been increased to 219,000 lb by adopting 310-lb boiler pressure with 30 × 34-in. cylinders and is by far the highest on record. Driving wheels were enlarged from 69 to 74 in. and represent the maximum for ten-wheel coupled locomotives.

Noteworthy among the powerful 4–8–4 type locomotives built in 1937 are 5 delivered by Baldwin to the Richmond, Fredericksburg & Potomac, Fig. 3 (31); 14 streamlined by Lima to the Southern Pacific for the coast route, Fig. 4 (32); and 20 by the American Locomotive Company to the Union Pacific for through passenger service from Omaha west. The first group should develop the greatest horsepower with a tractive effort of 66,500 lb, an adhesive weight of 277,250 lb, a grate area of 96.3 sq ft, 275-lb boiler pressure, and 5374 sq ft of evaporative surface. The second group has the distinction of being the largest streamlined locomotives, and their tractive effort of 62,200 lb in the main cylinders is supplemented by 12,500 lb in the booster. The Union Pacific engines have similar characteristics and 300-lb boiler pressure but no booster. Driving-wheel diameters of the three designs are 77, 72, and 77 in., respectively. All engines carry tenders of 20,000 to 22,000 gal water capacity.

Among the features of recent Canadian National Railways locomotives, a 1936 example of which is shown in Fig. 5, are improved Vanderbilt tender tanks having a bottom plate of 1-in. thickness, which is reinforced to act as a frame to which center plates and drawbar castings are riveted and welded. A separate tender frame is thus dispensed with and this construction has given absolute satisfaction for the last eight years With 250-lb boiler pressure, this locomotive develops a tractive force of 56,800 lb. Modern passenger locomotives of this

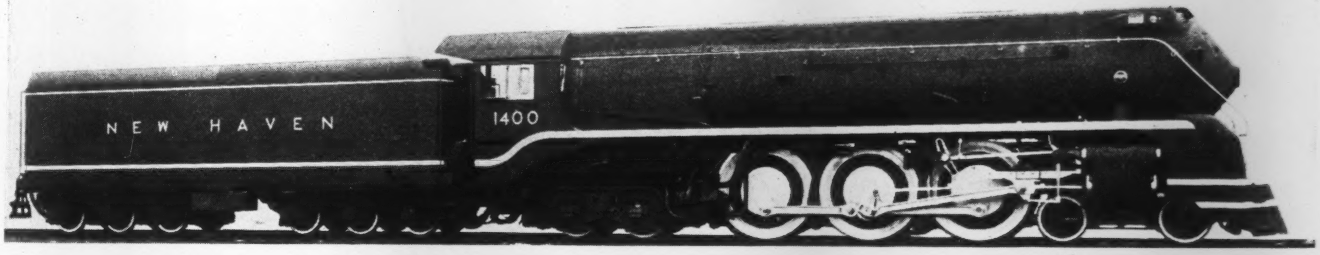
NEW HAVEN
1400

FIG. 2 NEW YORK, NEW HAVEN & HARTFORD HIGH-SPEED PASSENGER LOCOMOTIVE

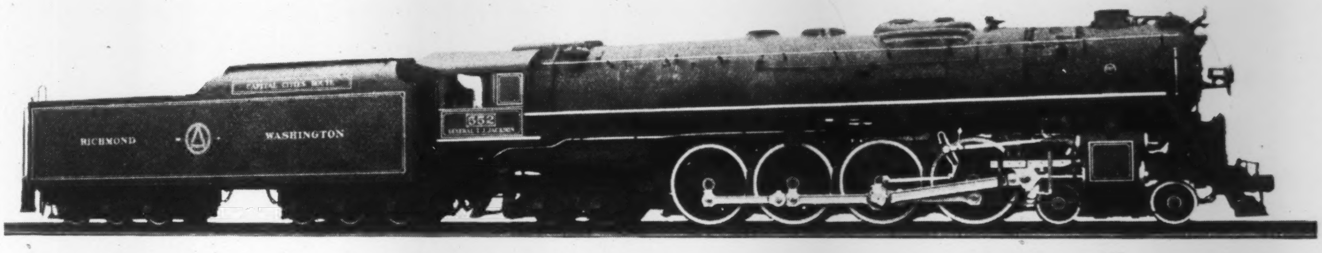
RICHMOND
WASHINGTON
552

FIG. 3 FREIGHT AND PASSENGER LOCOMOTIVE FOR RICHMOND, FREDERICKSBURG & POTOMAC

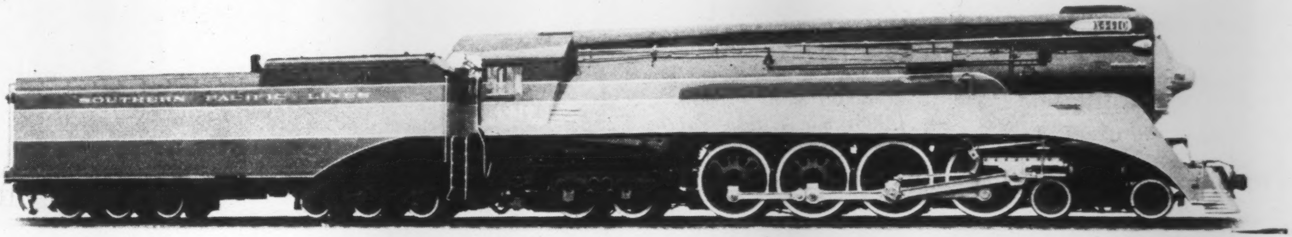
SOUTHERN PACIFIC LINES

FIG. 4 SOUTHERN PACIFIC PASSENGER LOCOMOTIVE

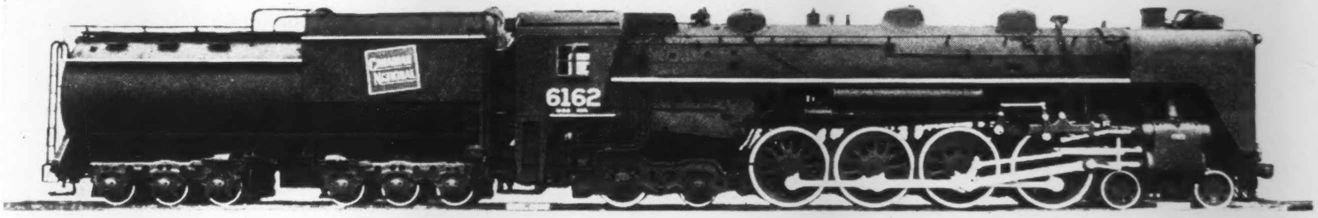

FIG. 5 CANADIAN NATIONAL MIXED-SERVICE LOCOMOTIVE

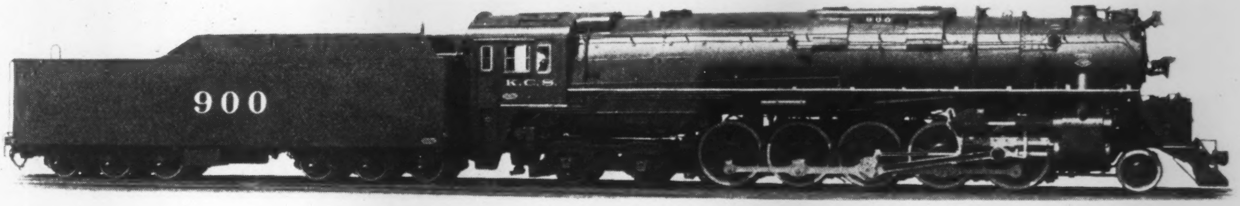

FIG. 6 KANSAS CITY SOUTHERN HEAVY FREIGHT LOCOMOTIVE

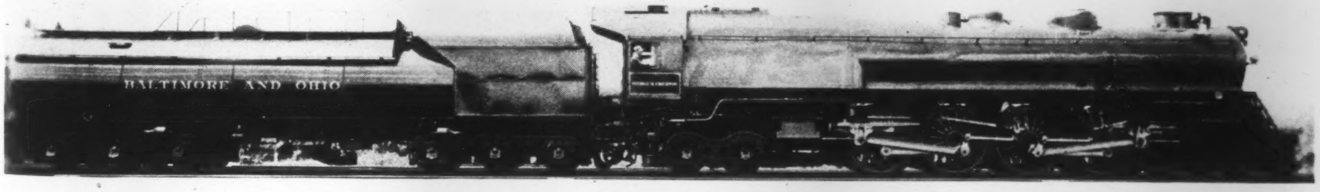
BALTIMORE AND OHIO

FIG. 7 BALTIMORE & OHIO FOUR-CYLINDER PASSENGER LOCOMOTIVE

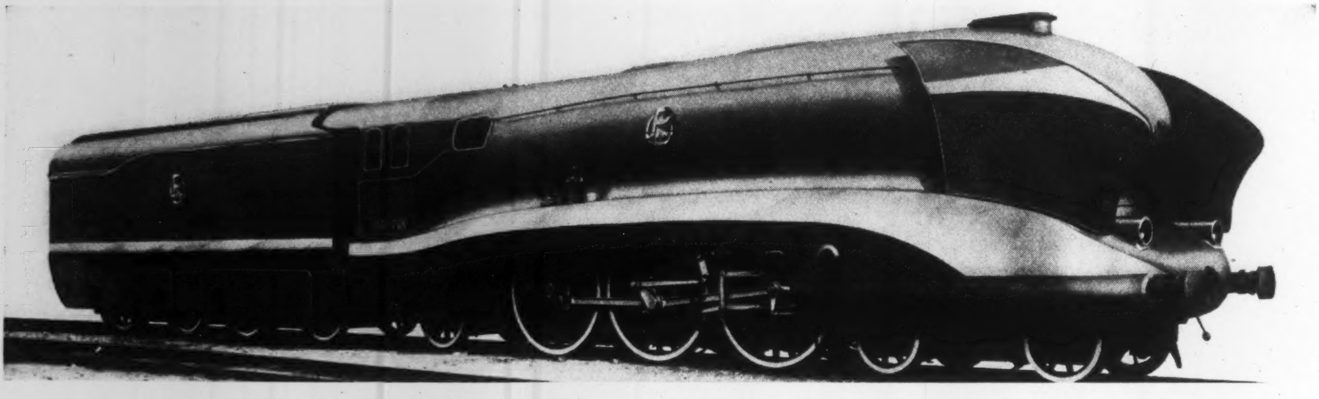

FIG. 8 PARIS-ORLEANS-MIDI STREAMLINED FOUR-CYLINDER COMPOUND LOCOMOTIVE

road, working on 300- to 800-mile runs, average approximately 10,000 miles per month and in some cases reach 13,000 miles.

The Bessemer & Lake Erie added twenty 2-10-4 type locomotives similar to those of earlier design for drag service in the Pittsburgh district. High-wheel 2-10-4 engines with 70-in. drivers, of which 10 were built by Lima for the Kansas City Southern, carry 310-lb steam pressure and are rated at 93,300-lb tractive effort with long cutoff. One of these locomotives is illustrated in Fig. 6.

High-speed Mallet designs of 1936 have been most successful, and substantial repeat orders were filled, the Union Pacific taking 25 of the 4-6-6-4 type (34) and the Northern Pacific 15 with the same wheel arrangement (35). The Southern Pacific had 14 additional units of its well-proved 4-8-8-2 type with the cab in front built, bringing the total to 77. These engines have 123,400-lb tractive force and handle also transcontinental passenger trains over 2.5-per cent Sierra Nevada grades.

Streamlining, apart from the instances mentioned, has found a few additional applications. The Union Pacific streamlined a Pacific-type locomotive with Timken roller-bearing rods and the Baltimore & Ohio, a President class Pacific of 1927 for service with the *Columbian* between New York and Washington.

One novel 4-4-4-4 type of high-powered passenger locomotive was completed by the Baltimore & Ohio in June, 1937. This is shown in Fig. 7. To reduce parasitic forces in the motion work, one pair of cylinders each has been placed front and back of the driving wheels and connected to two different axles. To provide a stiff bracing between the rear cylinders which adjoin the Emerson water-tube firebox, a one-piece Commonwealth cast-steel frame of 60-ft length has been used, with all four cylinders cast integrally. Carrying 350-lb boiler pressure, a tractive effort of 65,000 lb is produced by the 18 × 26½-in. cylinders with only 89,000-lb piston thrust and 76-in. drivers. The engine weighs 391,550 lb, the factor of adhesion is 3.70, and the maximum static axle load is 61,660 lb. The rigid wheelbase extends only between the inner driving axles; thus, the side rods are subject to horizontal angular movement due to the lateral play of the outer drivers, but no special provision is made to take care of it. Tests showed that the long exhaust pipe from the rear cylinders increases back pressure between 10 and 20 per cent over that for the front cylinders.

The Union Pacific 5000-hp turbo-electric locomotive is still under construction. The Babcock & Wilcox Steamotive boilers, of which two will be provided, have already been described in detail (36). Boiler control will be automatic. The first locomotive in this country equipped with fully automatic control of firing dependent upon boiler pressure was the 0-4-0 oil-burning switcher for one-man operation developed in 1935 by Baldwin (37).

New high-speed steam-locomotive developments by the Pennsylvania and the Baltimore & Ohio are under way. Both will be streamlined and have four pairs of drivers. The former, destined to match the 4700-hp output of the 4-6-6-4 electric locomotives of that road, will be driven by four outside cylinders. A committee from the three principal locomotive builders cooperated with the railroad in the design work. The Baltimore & Ohio engine will receive individual-axle drive by

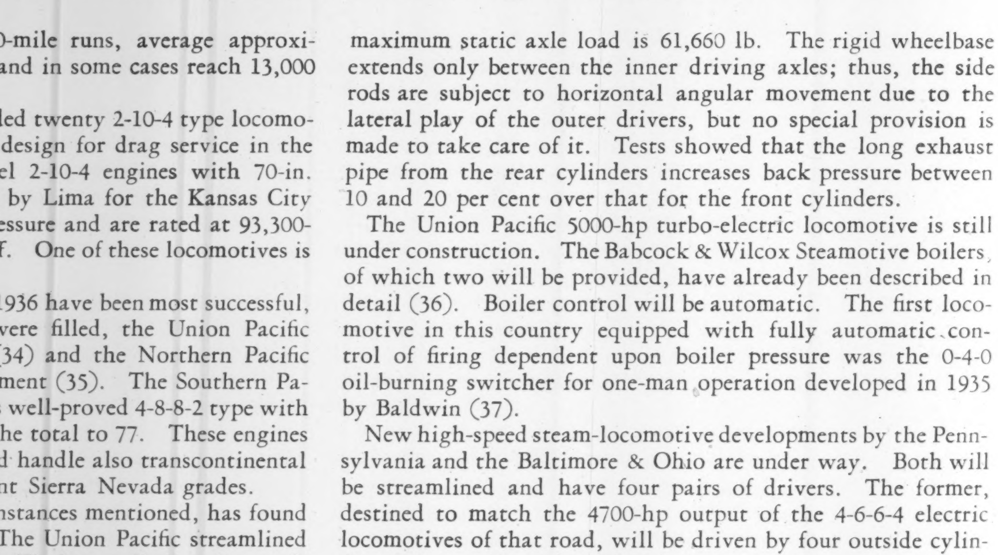

FIG. 9 FRENCH STATE RAILWAYS 4-6-0 LOCOMOTIVE WITH HUET DEFLECTORS AND LIGHTWEIGHT TRAIN

four Besler four-cylinder geared high-speed steam motors for 350-lb pressure, along the general lines discussed in last year's report in connection with developments in France and Germany. A tractive power of 72,000 lb with 3.6 as factor of adhesion and an engine speed of 1300 rpm at 80 mph is contemplated. Construction of this locomotive is about to begin.

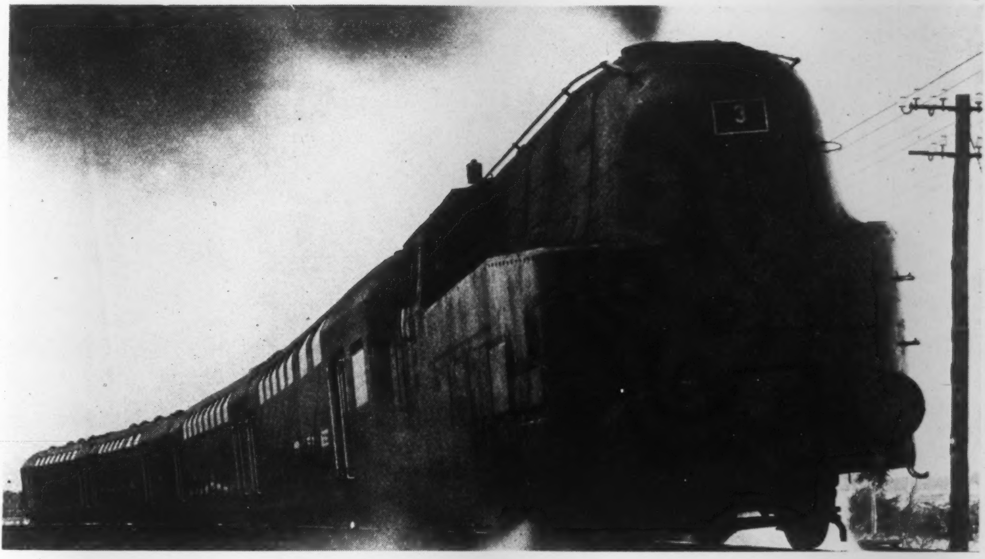

FIG. 11 THE THIRD DOUBLE-DECK TRAIN OF THE GERMAN LUBECKBUCHENER RAILROAD

STEAM LOCOMOTIVES ABROAD

With the exception of Great Britain, where the building of 532 steam locomotives had been authorized for the current year, corresponding to last year's figure and to a replacement quota of about $2^1/_2$ per cent, and probably, of Russia, orders placed by the world's principal railroads again hardly exceed a replacement quota of 1 per cent. Better utilization and modernization of existing equipment as well as experiments with new designs essentially contribute to the lag in general orders. Reorganization of locomotive servicing and repair facilities is a major topic. A recent detailed report on the extensive measures taken by the London, Midland & Scottish Railway contains an outstanding analysis of locomotive time (38). Hours in traffic per day, for example, rose 21 per cent since 1929 to almost 14 hr per engine in use, daily mileage rose 25 per cent to over 118, and the inventory was radically reduced.

In France, only a few new locomotives were built this year, but experimental work as discussed later has been extended further, so that French railroads are intensifying their activity as principal sponsors of steam-locomotive development along novel lines. Transformations of existing locomotives according to the principles advocated by Chapelon already number over 400. Recent improvements on 4-8-2 type locomotives on the Est System (39) resulted in 45-per cent increase in drawbar horsepower at 75 mph or from 1580 to 2290. Remarkable success has been achieved by seven 30-yr old Atlantic-type locomotives that were streamlined and modernized last year by the Paris-Lyon-Méditerranée and are hauling four-car trains between Paris and Marseilles at an average speed of 59.6 mph. This service had already been mentioned in connection with the development of high-speed services abroad. The Paris-Orléans-Midi streamlined one of its well-known Chapelon 4-6-2 locomotives as shown in Fig. 8 and tests last summer showed a resultant gain of 130 hp at 75 mph. More detailed figures on power saving and discussions of streamline designs and formulas are presented in a recent article by Dr. A. I. Lipetz (40). A system of partial streamlining by Huet deflectors is being tested on the French State Railways on a modernized ten-wheel type of 1912 with four cylinders and simple expansion from 199-lb steam pressure, which is illustrated in Fig. 9. The deflectors are reported to be effective in destroying the eddies that are ordinarily formed, thereby decreasing resistance, although lacking the esthetic qualities of full streamlining. On May 28, 1937, the test engine was put in service between Paris and Le Havre, and, although weighing only 160,000 lb exclusive of tender and having a grate area of 30.0 sq ft, matches the 141-mile nonstop schedule of the Bugatti rail cars at 72.1 mph average speed with a train of 198 tons accommodating 332 persons (41).

In May, 1937, the London, Midland & Scottish Railway completed the first of a series of five high-speed Pacifics, shown in Fig. 10, for service on the *Coronation Scot*, covering the 401 miles between London and Glasgow, at a commercial speed of 61.8 mph. They were developed from the earlier Princess class and have about the same rated tractive force of 40,000 lb and four 16.5 × 28-in. cylinders, but considerably larger boilers. The grate area is 50 sq ft, the heating surface is 2808 sq ft plus 856 sq ft in the superheater, and the working pressure is 250 lb. With a weight of 151,000 lb on the 81-in. drivers, the factor of adhesion is low, 3.75, reflecting upon the difficult profile over which these engines run. The copper firebox has a combustion chamber. Alloy steels have been used for many parts, including boiler shell, frame plates, and motion work. Since ample opportunity is provided to take water en route, tender capacity is moderate, 4800 U. S. gal of water and 11.2

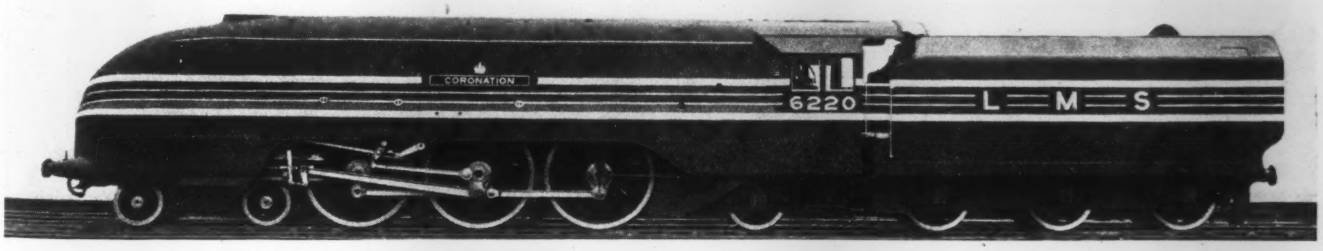

FIG. 10 LONDON, MIDLAND & SCOTTISH RAILWAY'S *Coronation* TYPE LOCOMOTIVE

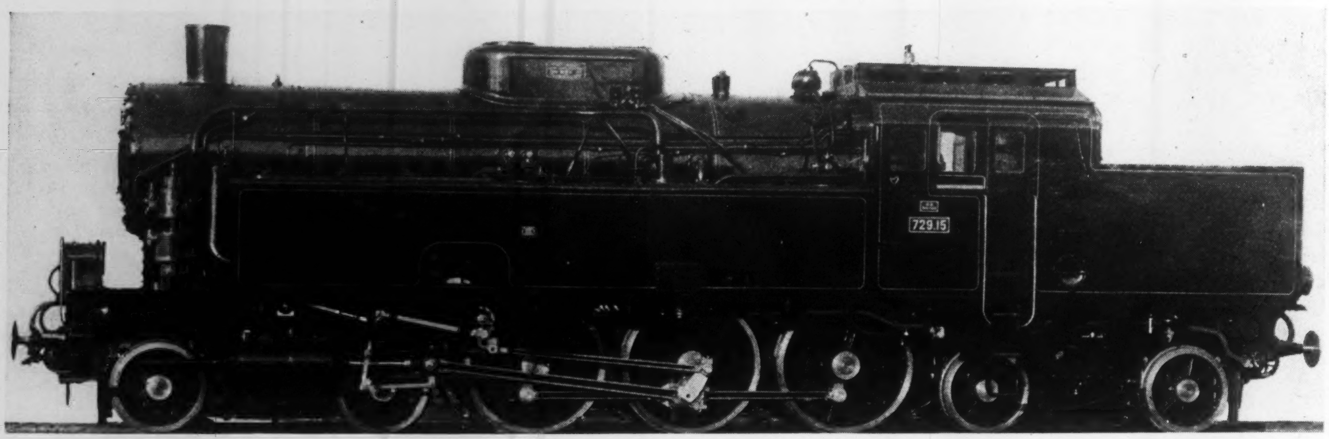

FIG. 12 AUSTRIAN CLASS 729 TANK LOCOMOTIVE

tons of coal, so that the locomotive with half-loaded tender totals 337,000 lb (42). The London & North Eastern's nine-car, 341-ton *Coronation* train to Edinburgh is likewise hauled by Pacific-type class A4 locomotives (43) corresponding to the *Silver Link* of 1935. They carry 250-lb boiler pressure and develop 35,500-lb rated tractive effort in three cylinders. With half-loaded tender, the total weight of 340,000 lb corresponds to 50 per cent of the trailing load in the *Coronation* high-speed service. This railroad is likewise concentrating upon rationalization of maintenance. The average yearly mileage of the 4-6-2 type express-passenger locomotives in 1936 was 67,340 with a maximum of 80,015 for any one engine. These engines work under varying conditions, hauling besides, high-speed trains, heavy loads approaching 650 tons.

The German State Railways received in May the first of the new 2-10-2 class 45 high-speed freight locomotives for 56 mph, as announced in last year's report (44). This engine is designed along conventional lines following standard practice in Germany. Three single-expansion cylinders develop 68,000-lb tractive effort at 85 per cent boiler pressure or 284 lb. Weight on the 63-in. drivers is 221,000 lb, the factor of adhesion is thus 3.25 to obtain small cutoffs. Each wheel is sanded to prevent slipping. Grate area is 54 sq ft and fireside heating surface 3110 sq ft plus 1425 for the superheater. All these dimensions are maxima for Germany except the total engine weight of 282,000 lb which is slightly surpassed by the 4-6-4 streamliners, class 05 of 1935. Tests are now being conducted at the Grunewald stationary plant. The German Lübeck-Büchener private railroad has extended its double-decked train service and, apart from a third new 2-4-2 tank locomotive, several older engines have been adapted for these trains. Fig. 11 shows one of these applications.

In Austria, various refinements contributing to sustained performance have made the 4-6-4 series 729 tank locomotives that were purchased in 1936 suitable for a much higher class of service than was originally planned for these engines, Fig. 12. Weighing only 218,000 lb with half-loaded tanks, they haul the eight-car 460-ton *Orient Express* from Vienna to Linz, 117.8 miles of difficult route with many curves and long grades of 0.4 to 1.1 per cent at 45.0 mph exclusive of one stop and the five-car 292-ton *Arlberg Express* nonstop at 49.0 mph. Engine weight is only 24 per cent of the trainload in the first case and 37 per cent in the second. Older 2-6-4 type locomotives weighing 30 per cent more have been replaced in this service. The tank engines have 38 sq ft of grate area, a Nicholson thermic syphon, 2000 sq ft of heating surface plus 558 sq ft of superheating surface, and moderate steam pressure of 185 lb. Standard Lentz poppet valves with oscillating cams are used and light working parts of plain carbon steel. Wheel diameter is 63.5 in., and the tractive force is 27,200 lb (45). In service with heavier passenger trains between Vienna and Salzburg, 195 miles, and Vienna and Passau, 183 miles, with weights up to 700 tons, average speeds of 43.0 to 47.0 mph and a 75-mph speed limit, the 14 powerful 2-8-4 type class 214 locomotives mentioned in last year's report aggregated 3300 miles per day in July, 1937, and used only 5.08 lb of coal having a heating value of 12,600 Btu per passenger car-mile with cars of 90,000-lb average weight. These engines also have poppet valves, an ample tractive force of 44,200 lb, and perhaps the highest superheat of standard European locomotives, reaching 806 F at high sustained output. Average yearly mileage of these locomotives is 78,800 per unit. Those of 1936, which are equipped with the new Friedman type journal-pressure lubrication, reached up to 9020 miles per month or

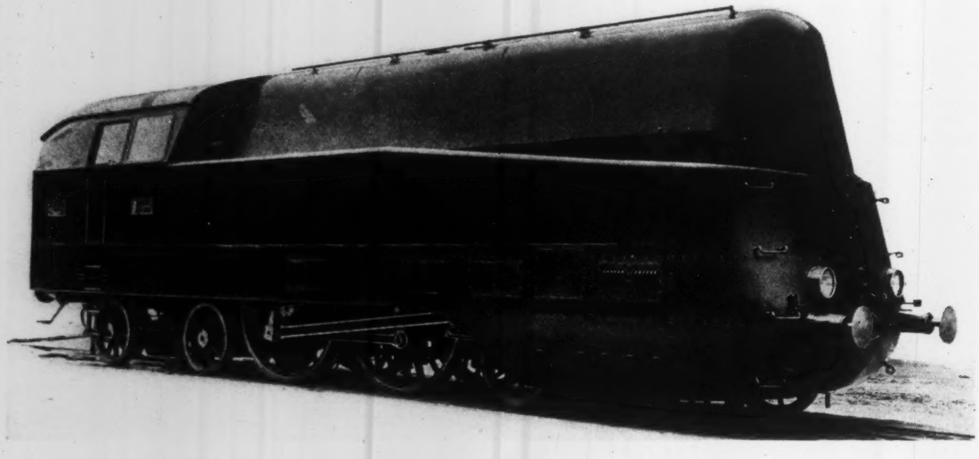

FIG. 13 HUNGARIAN STATE RAILWAYS STREAMLINED TANK LOCOMOTIVE

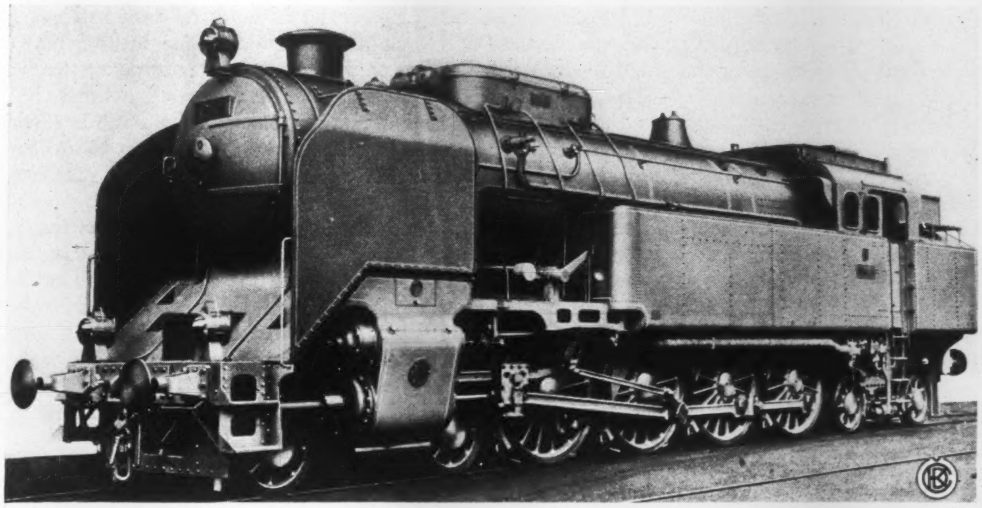

FIG. 14 EXPERIMENTAL THREE-CYLINDER TANK LOCOMOTIVE OF THE CZECHOSLOVAKIAN STATE RAILWAYS

37 per cent more and were successfully tested at sustained speeds up to 96.4 mph; 46 of these engines have already been built for Rumania.

A light 4-4-4 streamlined tank locomotive of the Hungarian State Railways is shown in Fig. 13. Grate area is 29.5 sq ft, tractive force is 20,200 lb with 256-lb boiler pressure, and the total weight with 50 per cent fuel and water supply is 167,000 lb. Service particulars have not been announced thus far.

An experimental 4-8-4 three-cylinder tank engine, No. 475001, has been in test service on the Czechoslovakian State Railways since 1936. The striking feature is the cylinder tractive effort of 51,700 lb, with an adhesion weight for fully loaded tanks of only 134,600 lb, corresponding to the extreme adhesion factor of 2.6. This engine, which is illustrated in Fig. 14, has a conventional long-travel piston valve gear and no special measures appear to have been taken to prevent slipping. Comparison with the same road's two-cylinder 4-8-4 class 464 tank engines of more conventional proportions, tractive force of 38,800 lb and adhesion factor of 3.28 with full tanks, should be instructive. The Czechoslovakian State Railways, having a preponderantly difficult profile, are generally using low adhesion factors, for instance 3.20 for their Pacific-type locomotives, which have driving wheels that are 77 in. in diameter.

At the Paris World's Fair, the Polish State Railways exhibited a fine streamlined Pacific-type locomotive received in May this year. It is shown in Fig. 15, was built to haul 330 tons at 87 mph, is of light construction, and weighs 207,000 lb plus 109,000 lb for a half-loaded tender which is capable of carrying 8500 gal of water and 10 tons of coal. Tractive power is 33,100 lb, which is developed in two cylinders, and adhesion factor on the 79-in. drivers is 3.44. The boiler carries 256-lb pressure and has 41.5 sq ft of grate area.

Early this year, the State Railways of Turkey received from Henschel in Germany three 2-8-2 type passenger locomotives for 62 mph and two 2-10-0 type freight locomotives for 44 mph. They are built to German standards for 40,000-lb axle load and have identical boilers, cylinders, and many other parts (46).

In Russia, the 2-8-4 wheel arrangement, first chosen in Austria for high speeds, has been adopted on streamlined engines for 87 mph, with 81.2-in. wheels, the largest ever used in an eight-wheel coupled locomotive. The outward appearance of the *Stalin* class engine resembles that of the New York Central's *Commodore Vanderbilt*. No details have been released (47.)

Of the special-type locomotives announced in last year's report, the German 4-6-4 high-speed locomotive with pulverized-fuel firing and the cab in front was completed in July on the occasion of the Borsig Locomotive Works' 100th anniversary. Like the two earlier German 4-6-4 streamliners, it is designed for a service speed of 109 mph. Since this is the first engine especially designed for pulverized fuel, in contrast with the conversions heretofore undertaken, results will be awaited with particular interest.

The French Nord Railway's 4-6-4 with independent-axle drive is expected to be ready next spring. Independent-axle drive by turbines is to be incorporated in a noncondensing 4-6-4 type worked out by the French Railroads' Central Research Office. This appears to be the only new turbine-locomotive project in progress outside of the United States.

Installation of condensing tenders for conventional reciprocating engines is being taken up on a large scale by the Russian railways which are reported as building 150 this year (48). This constitutes the culmination of efforts begun in 1933 when such a tender was delivered by Henschel of Germany for a 0-10-0 freight locomotive (49). In contrast to earlier attempts in this field, the condenser is not built to create any substantial vacuum but merely serves to condense the steam at a

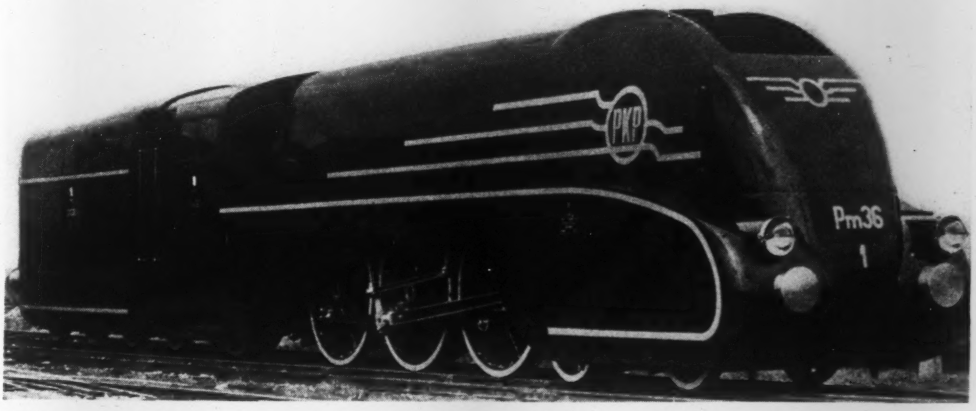

FIG. 15 POLISH STATE RAILWAYS HIGH-SPEED PACIFIC-TYPE LOCOMOTIVE

temperature of about 195 F, thus avoiding excessive weights. The new arrangement differs from the original one principally by meticulous provisions for complete removal of oil from the exhaust steam which passes through a coal filter located under the boiler and then through two successive filters with fibrous organic substances in the tender. In an endurance test last winter with a train of 1330 tons, the run from Moscow to the Pacific Ocean and back, 12,970 miles, was made in 487 hr running time. Fresh-water consumption was 8.2 gal per mile or 11 per cent of that for standard locomotives, but a consumption of less than 5 per cent has been found in tests with the original Henschel equipment and is held to be attainable. While no figures have been obtained for the new locomotives, the condensing tenders built by Henschel weighed 60 per cent of the engine when light and 72 per cent when half loaded. Judging from the capacity of the draft-producing turbine, which is given as 90 hp, the capacity of the new locomotives may be about 2000 ihp. Cooling fans for the 23,500-sq ft condenser are driven by a 180-hp exhaust-steam turbine. Operating conditions are extremely severe, entailing temperatures between —40 and +120 F.

The French Paris-Orléans-Midi Railways are planning the construction of a high-efficiency 2-12-0 freight locomotive of 4000 hp with two high- and four low-pressure cylinders, oscillating-cam poppet valves, 256-lb boiler pressure, and reheating of the receiver steam. For light service in competition with Diesel trains, a 4-6-2 compound tank engine is planned with four outside cylinders and is expected to develop 2000 hp with a grate area of only 22 sq ft by application of the Chapelon principles of design.

STEAM-LOCOMOTIVE DETAILS

The Velox boiler for the French Paris-Lyon-Méditerranée Railway as reported on last year has been mounted on the engine frame and standing tests have been successfully concluded. Current labor conditions in France delayed this and other projects, and, incidentally, made it impossible to obtain from France availability and mileage figures that could be considered representative.

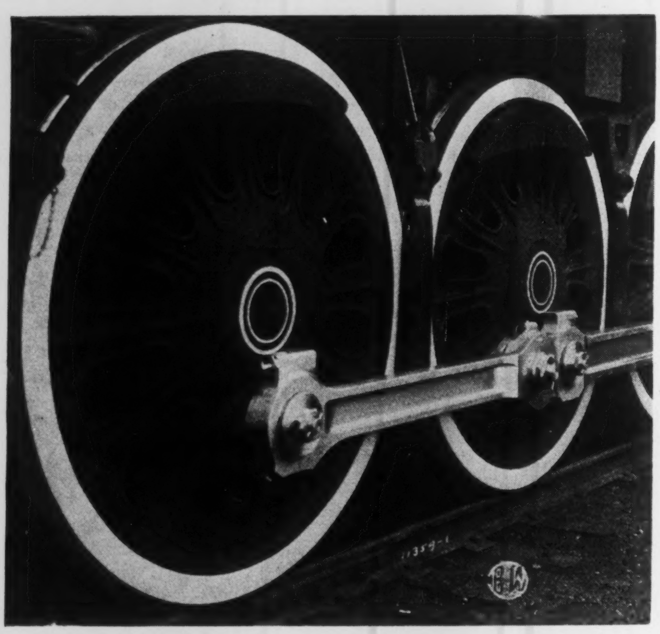

FIG. 16 BALDWIN DISK WHEELS, 77 IN. IN DIAMETER, ON THE RICHMOND, FREDERICKSBURG & POTOMAC 4-8-4 LOCOMOTIVE

Results with the experimental Yarrow water-tube boiler (50) on the London & North Eastern's 4-6-4 type locomotive of 1930 led to the decision to replace it by a conventional unit. This again testifies to the extreme difficulties encountered in substituting a design lacking the characteristic rigidity and simplicity of the Stephenson boiler, which rigidity and ability to absorb large external forces makes it literally the backbone of the conventional steam locomotive. Water-tube firebox developments have been absent, except for continuation of the Baltimore & Ohio's known policy. Elsewhere in the world, the tendency is to use approximately 300-lb pressure in conventional boilers, and the all-welded steel firebox is also making progress outside of the United States, where the requirements for successful use of steel are gradually being realized (51). For combustion rates up to 200 lb per sq ft of grate area, as obtained in French capacity tests, welding the tubes to the rear flue sheet as practiced in this country was found necessary to prevent leakage and this practice is therefore spreading. An outstanding experiment is the Delaware & Hudson's all-welded boiler, built after extensive research in cooperation with representatives of the three principal locomotive builders and other agencies (52). The boiler is to be operated under strict supervision.

Developments affecting firebox design include seating flexible Flannery stay bolts directly on the shell instead of on a screwed-in plug and provision of a welded cap. The American Arch Co.'s new arch tubes are fabricated by welding and connect the side water legs of the firebox with the crown sheet in the form of an inverted Y, whereby circulation is improved and the bricks receive a support far superior to that offered by the old longitudinal arch tubes. A downflow syphon, wherein no water connection to the lower front of the firebox exists, so that the supply is drawn exclusively from the rear water leg and the syphon is free to expand forward (53), has been proposed and was exhibited at the Association of American Railroads Convention last June.

Great variety is still found today in boiler proportions; tube lengths range from 18 ft for the New Haven's 4-6-4 type to 25 ft for the Baltimore & Ohio's 4-4-4-4, with flues and tubes having the same diameter in both cases, namely, $5^1/_2$ and $2^1/_4$ in., respectively, and comparison of the results should be worthwhile. Some indications regarding the effect of long and relatively narrow flues upon superheat can be obtained from test results of the latter locomotive, where the steam temperature for the 40-element superheater was only 580 to 600 F at an indicated performance of between 2342 and 2590 hp and from 330 to 340-lb boiler pressure. Considering many past investigations, the problem appears to be more one of coordination than of new research.

Elesco type E units have been redesigned at the smoke-box end to remove the bends hitherto placed in the gas stream after the bifurcation, with a reduction in cinder abrasion.

Particularly where effective draft production permits high combustion rates, boiler capacity is often found to be limited by water carry-over. Consequently, more attention is being paid to sufficient steam space and the Elesco centrifugal steam dryer is finding favor.

No new developments appeared in boiler front ends, but the desire for clearing up the many problems involved is evidenced by tests continuously in progress on many railroads all over the world. A scientific analysis of draft production and its relation to combustion apparently is needed to produce a basis for more concise judgment.

The French Nord Railway is the first in Europe which is about to equip a number of locomotives with mechanical stokers. The Simplex type BK has been chosen, on the basis of extensive tests, for 2-10-0 type freight locomotives handling 2200-ton trains and having a long, narrow grate of 38.6 sq ft suitable for high combustion rates.

Application of poppet valves is making moderate progress as reported last year. The latest type of Caprotti gear used on the Alsace-Lorraine railroads has been described in much detail (54). As evidenced by the material included under the headings of American and Canadian Steam-Locomotive Design and Steam Locomotives Abroad, no agreement has been reached on the factors of adhesion desirable for given operating conditions. On high-powered two-cylinder locomotives, narrow limitations of a mechanical nature are imposed, but the various multiple-cylinder arrangements now in prospect may lead to more complete expansion of the steam by using larger effective cylinder volumes.

Narrow piston and valve rings are found preferable to wider rings on many railroads. The Austrian Federal Railways report wear reduction to one third by substituting six rings of $^{5}/_{16}$-in. width for three $^{5}/_{8}$-in. rings for high-speed pistons. Welded steel cylinders with cast-iron liners have been used in the modernization of the French State Railway's 4-6-0 four-cylinder compound engine described earlier in this report. While this is an isolated experiment, welding of locomotive parts is spreading rapidly.

The well-known Franklin locomotive booster has been redesigned for higher operating speed of 35 mph, a cut-in speed of 21 mph, and up to 350-lb steam pressure to take care of present requirements. It is designated as type E.

Since bearing performance is a major factor in availability, improvement of lubrication is widely sought, as will be discussed under miscellaneous matters. Roller bearings have been applied to a majority of this year's new United States locomotives; in many cases to all axles and in a few cases to rods. A housing for driver applications, a section of which is removable for inspection of the bearing has been developed by SKF. Needle bearings have been accepted for the Baker-Pilliod valve gears, and on the New Haven no wear was noticeable after 90,000 miles of service. Their use is also increasing abroad, particularly in Great Britain.

Wheel design made progress in this country, stimulated by the advent of the box-type wheels. A fine example are the 77-in. Baldwin disk wheels that are shown in Fig. 16 on the Richmond, Fredericksburg & Potomac's 4-8-4 type locomotive. They consist of carbon-manganese steel of 92,000-lb tensile strength. The Krauss type of leading truck, combining one pair of carrying wheels with one pair of driving wheels to form the equivalent of a conventional four-wheel truck, is gaining increased recognition abroad. Fig. 17 shows the design used in the Austrian 2-8-4 type locomotive. It permits worthwhile savings in length and weight. The new German 2-10-2 high-speed freight engines are so equipped, as well as the 2-8-2 class E18 electric locomotives for 93 mph.

More attention is being paid to design problems as a result of failures and wear brought about by dynamic forces; full-size axle testing equipment, for example, has been installed by Timken (55) and the design of driving parts is being intensely studied (56, 57).

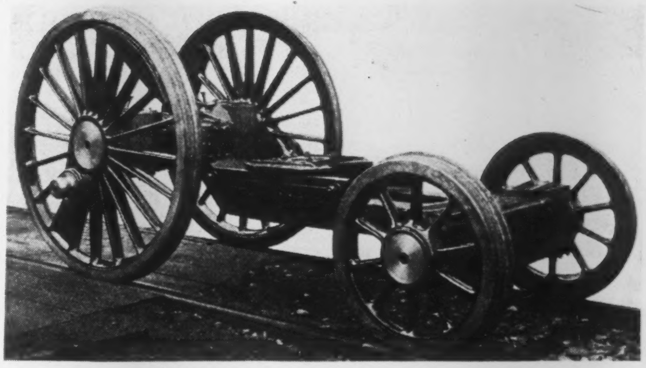

FIG. 17 KRAUSS-TYPE LEADING TRUCK FOR 76.4-IN. DRIVERS ON AUSTRIAN 2-8-4 LOCOMOTIVE

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(*To be continued in January*)

Adequate Job Training for Accident Prevention

(*Continued from page 924*)

leaders, or straw bosses under them should lay special emphasis upon their safety training. These men are in key positions when it comes to the avoidance of accidents. Men of the subforemen class are, as a matter of fact, much more important in many respects than is usually recognized. To many workers straw bosses or gang-leaders are the only persons of authority with whom they have direct contact. Because of the straw bosses, relative unimportance in the eyes of management, their collective importance throughout the organization is too frequently overlooked. The foreman can safeguard his own safety record by training his subforemen thoroughly in every detail of safe workmanship.

Step 10. Every foreman should have a departmental bulletin board that he can use effectively in displaying departmental safety facts, safety posters, safety exhibits, and a great variety of information with which to keep safety alive in the minds of his men.

SAFE FOREMANSHIP PAYS IN REDUCED HUMAN SUFFERING AS WELL AS IN MONEY

Efforts of a foreman to prevent accidents pay in more ways than one. Entirely aside from the money saved through reduced workmen's compensation payments and hospital and doctor's bills, are the more important savings measured in terms of reduced human suffering and pain.

Along with effective accident prevention go a number of worth-while by-products. The same practices on the part of a foreman which make his department a safer place in which to work also make workmanship more efficient, improve quality of workmanship, save breakage and damage to tools and materials, and increase the spirit of coöperation among workers. No means are available to measure the intrinsic value in dollars and cents of these important by-products of good safety work.

However, we all know that their total value far outweighs the dollar-and-cents value of reduced direct-accident expenses. The cooperation that is developed in accident prevention is easily transferred to cooperation in all activities of the department.

Never has there been a time in industrial relations when factors that build good will are more valuable than today. Effective accident-prevention work is a noncontroversial field where better employer-employee relations can be built. A sincere interest in the physical well-being of workers inevitably results in good-will value that is so much needed at present. Safety work furnishes one of the most effective means by which management and men can get closer together and who can estimate how much the good will value of effective accident-prevention work may be in your organization and in mine?

Technological Planning

(*Continued from page 930*)

Even if a feasible plan could be formulated, the carrying out of the plan would raise additional problems. It would involve, for example, the placing of additional authority over economic activities in the hands of the central government. Whether such a shift of authority is desirable is a question about which much may be said on both sides. But it may seem to many observers that an administration which passes into the control of a new party even four or eight years is hardly adapted to the carrying out of a long-range program of national planning. It may seem that the government will have all it can do to discharge efficiently the many new tasks it has taken on in recent years.

But whatever the objections or obstacles to national planning on a comprehensive scale, the possiblity of easing the adjustment of society to technical change should be thoroughly explored. The setting up of committees to study technical trends is therefore desirable. We know woefully little about this subject. The National Resources Committee which submitted their report describe it as "The first major attempt to show the kinds of new conventions which may affect living and working conditions in America in the next 10 to 25 years." But it is significant that David Weintraub, the author of the section on "Unemployment and Increasing Productivity," was compelled to state that "the material available concerning the question of what happens to workers who are displaced as the result of changing industrial techniques is very scattered and inconclusive."

Mr. Weintraub concludes that "the problem of technological unemployment is essentially twofold: One, the expansion of total production sufficiently to overcome the effect on unemployment of declining labor requirements; and two, the adjustment of the individual to employment dislocations which accompany technological progress." He presents statistics to show that since 1920 the required expansion of production has not taken place. It is obvious that a comprehensive study of the social effects of technological progress must include a careful consideration of this problem. Mr. Weintraub leaves it with a few suggestions as to possible methods of approach, remarking that the emphasis to be found in recent economic literature is on the frictions and rigidities of the economic system.

SIGNIFICANT REPORT, WORTHY OF WIDE AND CRITICAL READING

This is a significant report and should be given a wide and critical reading by engineers, economists, and sociologists. The proposal for a continuous study of technical trends in industry is beyond criticism. The need for social action to cushion the social impact of disturbing technical innovations is clear. But the problem of the best means of social control needs careful consideration. This problem is international as well as national in character. There is danger that our efforts to reduce the social disturbance may actually intensify it by injecting additional frictions or rigidities into the economic system. The ideal is to hasten the adjustments which would eventually be made—though with considerable loss, want, and suffering—through the operation of economic forces. But political action may delay as well as hasten the operation of these forces which in the past have adjusted the industrial system to the arrival of new techniques.

FORGOTTEN ECONOMIC FACTS

By Way of Reminder

By WILLIAM D. ENNIS

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THE management division of the A.S.M.E. Metropolitan Section originally asked me to summarize the discussions of the seventh annual Johnsonburg conference, held last June. This did not seem feasible. It was agreed instead that I should attempt to outline the general drift of some of the thinking up there during these seven years.

Perhaps the task, as outlined in the published announcement, is overambitious. I offer as possibly my best qualification that of being a middle-of-the-road person. Perhaps, also, this presentation will seem, to those here who have given most thought to these matters, quite elementary. I admit it in advance. I am an elementary sort of person.

Engineers cannot, if they would, dissociate themselves from the human, social, and political issues which we now face. Like the two million young men and women who each year reach legal age and who must then choose an economic attitude, engineers must ally themselves with the right wing, the left wing, or the center.

The conservative: "Prove all things; hold fast to that which is good."

The radical: "Nothing can be worse."

The moderate is always in opposition.

Nowhere in any age have more than a negligible few of the population lived in anything approaching reasonable ease, based on present standards and desires. . . . Most of us are, and long will be, at a substandard level.

You cannot invest a dollar without eventually consuming goods and employing labor.

People have more faith in gold than in governments.

If wages are raised without any increase in production, there will be no more goods to be had in return for wages. . . . We cannot eat more than there is to eat.

Mere majority rule and freedom are incompatible. . . . to live under the absolute domination of a majority . . . would constitute the most extreme form of social insecurity . . . Certain . . . rights are not subject to the will of the majority. . . . A majority of . . . voters should rule . . . but . . . within limits. . . . Even votes settle nothing finally until they settle it right.

Our total of governmental debts (all jurisdictions) is now around $1550 per average family and is still increasing.

[From contributed discussion by Allen W. Rucker[1]]: . . . Total goods income of the nation when finally exchanged is a product of two variables, price and production. . . . We have only two choices; we can protect price and let production go to any low level it may, or we can maintain production and allow price to find its natural level. We can never protect both production and price and we never have.

The right wing is the conservative wing and at its extreme, too often (and unintelligently) reactionary. In many cases, at this extreme, it has been unscrupulous, irresponsive to the popular will, and (with repercussions of far greater significance) subservient to powerful special interests outside the government. Its better elements might adopt the slogan, "Prove all things; hold fast to that which is good." (The more reactionary groups perhaps modify the text and aim to hold fast that which is profitable.) With some force of logic in its favor, the right wing is generally averse to sudden or extreme change. It is reluctant to deal experimentally with the whole social structure.

The extreme left wing is highly critical of the hitherto established order, which the left wing regards as the result of many years of right-wing control. This left group is willing and eager to scrap whatever exists when it contemplates admitted wrongs. "Nothing can be worse" is its slogan. The radical always wants things *now*. He would override or destroy whatever delays him. Many of the left-wing adherents are high-minded men and women, devoted to the public good. But many, also, of their influential leaders have had little experience in government, or indeed in the successful management of any sort of business. They do not care. To your left-winger, a correct ideology is more important than demonstrated effectiveness.

The moderate, or middle-of-the-road person, is in an unhappy position. I know. Since a party in power tends (from his point of view) to extremes, the moderate is always in opposition. He seems to belong to the right when the left rules, and *vice versa*. He is perpetually disgruntled. It is a consequence of this that what I have to say will by many of you be regarded as one-sided. I am concerned with left-wing errors because the left wing is in power. The extreme right wing is a helpless old hag who has lost all her teeth and is not worth attacking. In what follows I am discussing not remembered, but forgotten, economic facts.

A long period of control by either right or left ends with an incoming party which lacks experience in government. Alternations of control between extremists involve unstable and unreliable governmental policies. Either condition is disturbing to economic order.

SHARING THE WEALTH

On this point, there is a wide range of positions possible. On the one hand is the (perhaps) average person who mildly deplores the extreme variations now existing in individual income and accumulated wealth but is not likely to do anything about it. At the other extreme are those, like G. B. Shaw, who advocate absolute equalization of money incomes.

We are all shocked when we contrast the ten-cent store heiress with one of the salesgirls, or the playboy who complains of the high cost of divorce with one of the workers in his inherited factories. Few of us pause at this point to apply a little

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Presented at a meeting of the Metropolitan Section, New York, N. Y., Oct. 14, 1937, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

[1] [Discussion by Mr. Rucker and others, with reply by the author, will be published later.—EDITOR.]

arithmetic. How much would it help the average ten-cent store employee to have the heiress exterminated and her income divided pro rata? And have the Ten Commandments been repealed (thou shalt not covet, thou shalt not steal)? The income is hers, according to the rules of the game hitherto existing. I suggest, although I cannot prove, that people covet it, not because it would help them greatly but because it is a larger income than theirs. If so, the motive is not equity but envy.

(Since I am quoting texts, I should of course remember that other one which deals with the camel and the eye of the needle.)

Your true wealth sharer replies that private ownership of productive facilities is wrong. One who believes it to be wrong is perfectly right in attacking the income of the heiress, also your invested savings and mine; ultimately, your salary and my pay envelope. And I am equally right in filing a lien on his pig—even though he has a pig. But then we must amend the Ten Commandments as well as the Constitution, in order to clear the record.

Moreover, an investment is necessary in order that the ten-cent store business be continued. It may be obtained in this case by confiscation. Later there will be required new funds for new enterprises. But pre-existing investments will have been confiscated. The new funds can then be derived only from taxation of the proletariat. They might as well, perhaps, have continued paying dividends to the heiress. And will the proletariat (now hypothetically in control) impose such taxation on themselves? If not, new enterprises will be impossible and progress retarded. Our limited experience seems to indicate that the proletariat prefer pyramidal borrowing as against any form of taxation to be paid by themselves.

And I have never understood why, if there is going to be a leveling, it should stop with national boundaries. Why not be logical and equalize with India and China, even though that means decreased incomes for our very poorest?

There may be parts of the world where equalization, if not reasonable, would at least be explicable. The United States is the last place to try it, because our system of universal opportunity and a wide spread of rewards has worked particularly well. In 80 years, in this country, average annual earnings of factory workers increased from $248 to $1320. In terms of the buying power of 1926, they increased from $413 to $1385 (U. S. Bureau of the Census). The International Labor Office at Geneva a few years ago (since 1929) gave the then relative purchasing powers of average real factory wages as follows: United States 197, Great Britain 100, Germany 77, France 58, Italy 43.

The basic objection to enforced sharing is neither religious nor arithmetical. It is psychological. Our present system provides education and opportunity for all or nearly all—for more of us all the time. It provides them for many beyond the point of diminishing returns. It offers the incentive of exceptional reward for exceptional ability. That incentive still exists for every one and has been adequate for many who started on the lowest rungs of the ladder. What does wealth-sharing offer as incentive? Its proponents are vague and evasive on this point. They talk of prestige, love of the work, popular acclaim. But where the thing is tried (I speak of Russia) the actual incentive rapidly returns to what is economic. High pay for high production is the Russian rule, which is the opposite of the G. B. Shaw rule. And in our own limited local experience it is incontestable that the vast majority of us make the money reward a major motive. Only a few become underpaid, though competent and devoted, public servants, professional religionists, teachers. The noneconomic incentives have only a limited appeal. Few find them adequate. Among these few I should perhaps include some of the formidable clan of bank vice-presidents.

This is the basic point. If we cannot save, and keep and use what we save, what incentive will there be for us to acquire and manifest high ability? Will we not rather become a race of buck passers?

PLENTY FOR ALL

Equalization of income (or an approximation thereto) is advocated on the ground that with redistribution there would be "plenty for all."

In the most prosperous years of the most prosperous nation (1928–1929, our own), the average annual income per family was substantially $2700. That was the total national income, divided by the total number of families in the country. Prices are lower now. The figure would have been about $2450, expressed in terms of today's price level. At the depth of the depression, 1932–1933, the corresponding figure (actual money, not equivalent money) was $1300. It was about $2000 in 1936. No amount of redistribution could of itself improve these figures.

Some poor families would regard such incomes as beyond the dreams of avarice, especially in certain sections of the country. But the many who live at about these levels will realize their total inadequacy for housing, medicine, dentistry, education of children, and reasonable recreation—to say nothing of several hundred dollars for support of government, which absolutely *must* come out of each such average income, if we carry through an absolute equalization.

Nowhere in any age have more than a negligible few of the population lived in anything approaching reasonable ease, based on present standards and desires. Deplorable, but true. The nearest arithmetical approach to the possibility of plenty for all ever recorded was here, in 1928–1929, under a system which is now by many denounced.

(I am not harking back to that period as a golden age. It was merely gilded. The standard of living, as we now know, which had been advancing steadily, then took a sudden spurt. In so far as the then-controlling system was to blame for the spurt and the consequent slump, it ought to be denounced.) One of my liberal friends suggests that we as a nation were surely spending then what we did not have, just as we are today. He adds, "In my opinion, prior to 1929, there was an attempt to raise the standard of living at a rate which was faster than is possible." I thought so at the time and remarked then that if you tried to do the business of 1930 in 1929 (by credit expansion) something was sure to happen.

Most of us are, and long will be, at a substandard level. In 1933, 99 per cent of occupied persons had incomes below $3930 (Cleveland Trust Company Bulletin, July 15, 1935). The highest corresponding figure ever attained was $8510. In 1933, the 1 per cent who received larger incomes than $3930 nevertheless received in the aggregate only 12 per cent of the total national income. The average over the whole period 1916 to 1933 was $12^1/_2$ per cent of national income to the favored 1 per cent.

We shall not realize plenty for all by "soaking the rich." Even an approximation to that ideal, by any mere redistribution process, involves soaking you and me.

There cannot be a higher average standard of living without an increase in the aggregate of production. We cannot eat more than there is to eat. To bring about such increase in production is not easy. The World War demonstrated the difficulty of effecting even a small percentage expansion of total output. We turned out more shells, but less (and inferior) household furniture and civilian clothing, and fewer houses.

Leftists assert that there is no difficulty about production, that we *can* produce "plenty for all," and that the trouble is a lack of buying power on the part of the great mass of the people. This lack is due, they say, to the withholding of rents, bonuses, profits, royalties, interest, and dividends; in brief, to the high returns paid to managers and investors.

They (and some others) then assert that an approach to equalization of income would increase aggregate buying power. The family with $2000 yearly *must* (they say) spend practically all it has to spend, while the multimillionaire may spend only 10 to 20 per cent of his income. Thus aggregate consumption is less than it might be, the goods produced cannot be sold, farms and factories turn out less than they could, and there is a lack of employment. Underconsumption has acted to decrease production.

But (to ask once more what has been asked by many) what does the millionaire do with the funds he does not "spend" for consumable goods? He saves them. That is, he invests them, directly or indirectly. Now it seems to me that you cannot invest a dollar without eventually consuming goods and employing labor. The effect of investment (from the standpoint of this argument) is exactly the same as that of "spending." The only part of the national income which is possibly withdrawn from the return flow of buying power is that part which is hoarded—buried in the earth, or in a safe-deposit box. (A bank deposit, of course, is not hoarded money.) The amount of such part we do not know, but there are some reasons for believing it to be relatively small, and that much of it is hoarded by the "poor."

To bring about a general increase of production, we need management of the best type, all the way from the top down. But those who advocate equalized distribution of the goods produced are refusing to pay for good management and thus not likely to obtain it. Moreover, they are destroying in the cradle the potential future supply of management talent, which I conceive to be the most valuable thing in the world.

The chief methods now in force for the redistribution of income are the graduated income tax and the inheritance taxes, with gift taxes to plug loopholes. Moreover, the safe return on investments has in this country been reduced by manipulation and otherwise to the lowest level in our history, thus diminishing the claim on production which is set forward by the investing public. These policies discourage and in time destroy large accumulations. They are a burden on even comparatively small investors. At the same time the little fellow who congratulates himself that we are "soaking the rich" is usually unaware of the taxes indirectly paid by him—part of the tax on realty, all—as I think—of the tariff revenues, etc.

"Plenty for all" is an ideal but not an immediate possibility. We were approaching the ideal with considerable speed.

A large proportion of our people who are now in abject circumstances would consider themselves well off if incomes were equalized. Every stomach would be partly filled by the goose. But what of the golden eggs?

INFLATION

When we turn to monetary matters, I begin by making one admission, anticipating the critic who may ask, "What would you have done?" Some of the measures of the past four years may be justified on the ground of imperative necessity. We are not trying here to draw fine lines between (*a*) the necessary things, (*b*) those which might be plausibly argued to have been desirable, and (*c*) those (if there are any) for which no defense is possible. We are not now chiefly concerned with any question of blame. We are indicating some of the facts, their consequences so far, and their probable bearing on the future.

In the days when metal coins constituted the hand-to-hand money, gangsters sometimes filed, clipped, or sweated a small amount from a coin. The penalty was severe. But when the sovereign clipped (debased) the coinage, most often quite substantially, to finance war, or to maintain pimps and mistresses on a scale to which they were not accustomed, the situation was different. The king made a profit; he paid his bills—if he paid them—in spurious money. The good burghers shrugged their shoulders, praised God and the king, and paid—in higher commodity prices—the resulting tax. I think I need not explain why prices became higher.

When there came about the general use of paper money, the gold was kept in reserve. The paper merely represented the gold. People preferred paper for purposes of trade. And then it was discovered that a government could safely promise redemption in gold, even though the amount of gold held was only half or less than half of the amount of paper outstanding. This was because people had faith in government.

When government began to issue paper without regard to the gold reserve, people lost faith, as in our Civil War. Prices rose. The new paper money could not safely be made redeemable in gold. We recovered from the Civil War inflation when it appeared that the North was winning and it became clear that (*a*) there would be no more paper issued and (*b*) the government would pay gold for its paper then outstanding.

The modern debasement, or what is politely called "devaluation," "writes up" the value of the gold reserve, and thus tends to produce an appearance of ample adequacy. But people know that the dollar bill, which was good for 23.22 grains of pure gold, has been written down to 59.06 per cent of that value. People have more faith in gold than in governments. And no one can buy or hold more than a trivial amount of gold now, except governments and a few who are governmentally licensed to do so on a limited scale. Since March, 1933, general commodity prices have advanced 46 per cent (Oct. 2). I do not assert that this is wholly due to currency inflation.

Another common war and postwar device is for government to borrow for current expenses. It sells bonds. Having first created an "easy money" situation, and possessing more or less despotic powers over banks, the principal bond buyers, it is able to sell these bonds at high prices; i.e., to borrow money cheaply. Then these bonds can be put by member banks in the central banks as partial security for the issue of paper money. This mortgages the gold reserve and is one of the most important, thus far, of our many inflationary policies. It was approximately the form of inflation so successfully used in Germany to ruin that country.

It may be briefly added that we have a silver policy which involves our government's buying silver and issuing it to the public at valuations which are both far above its intrinsic value. No one knows how far this will go.

The government borrowing and silver policies (plus some others) help it to run with an unbalanced budget. They relieve it, partly, of the necessity for immediate taxation. Our total of governmental debts (all jurisdictions) is now around $1550 per average family and is still increasing.

Any sort of inflation makes, and is intended to make, money worth less and goods (purchased by money) in turn worth more. That is, it causes a rise of prices paid for goods and services. It favors debtors as against creditors, speculators as against savers. The announced motive for our more than four years of inflationary measures was to make it easier for debtors to pay their debts. I have heard of no investigation of the equity of this proposal. It was asserted, apparently without evidence, that most of the debts had been incurred when prices were higher, and that creditors, if repaid, would receive more commodity purchasing power than they had lent. No weight was given the fact that both parties knowingly took this risk. Things might have worked out the other way. Would any defender of the lenders have then proposed to *increase* the weight of gold in the dollar? Perhaps Prof. Irving Fisher might.

More than this; many private contracts (recognizing a long period of inflationary agitation in our history) expressly stipulated that payment should be "in gold of the [then] present standard of weight and fineness"—i.e., 23.22 grains of pure gold per dollar. Our government set aside these contracts. In its own borrowings it had itself agreed to the same stipulation. This it repudiated. It refused to do what it had promised to do. The promise was made because the public feared that without such promise there might someday be some monkeying with the dollar. The monkeying occurred in spite of the promise. And the government, after prohibiting the private possession of gold, kept right on repeating the promise to pay in gold on new issues of its obligations.

Inflation hurts everybody who has money or to whom money will some day be due. This includes many of the poor, who have savings-bank deposits and life-insurance policies. A rise of 100 per cent in the general price level means simply and incontestably that these assets are written down 50 per cent. The man who "owns" a $6000 house on which there is a $4500 mortgage finds (eventually) that the house is "worth" $12,000, but the holder of the mortgage collects $2250 in purchasing power. By governmental action, the creditor's interest in the house has been reduced from 75 per cent to $37^1/_2$ per cent. It may be—I am not sure—that there are more debtors than creditors and hence that such a course is popular and will be backed by votes. But even votes settle nothing finally until they settle it right.

Bondholders, annuitants, pensioners are especially harmed by inflation. Their fixed money incomes are reduced in purchasing power by the increase in prices. Those whose incomes manifest inertia in responding to price changes—and this includes, for example, wage earners as well as landlords—suffer, although in less degree. A few venturesome and skillful persons, who borrow up to the hilt and pick up and hold well-selected commodities, equities, and real estate for rising prices, these make large profits, as did a group of postwar millionaires in Germany. And—from a rather narrow point of view—others of those whose obligations are purely money obligations, like banks and insurance companies, may neither lose nor gain.

Inflation is changing the unit of measurement after the bargain has been made.

Labor responds to rising prices with demands for wage increases, the demands backed by the sit-down strike.

LABOR AND WAGES

The wage problem has this year taken a new, complicated, and dangerous form.

What changes have occurred which may serve to explain this? There has been no sweeping or abrupt change in the attitude of employers. Among some large corporations, the movement has been rather toward moderation and recognition. But laws have changed, largely and suddenly. Administrative agencies under government have in recent months been generally regarded as partisan, i.e., prolabor. The new laws themselves are prolabor, although perhaps not as much so as those who administer them. And labor has imported a new technique.

If wages are raised without any increase in production, there will be no more goods to be had in return for wages. The principal effect is higher prices for the commodities purchased by labor, by all of us.

It may well be true that the important gains made by labor during the past century have been due chiefly to union activity; although it might on the other hand be shown that Henry Ford has advanced wages, furnished employment, stimulated skill, and provided wanted goods at low cost, all on a pretty large scale.

It is true that an increasing number of workers have come to depend for employment on a few strongly organized corporations; yet this number still constitutes a minority of gainfully occupied persons. Many workers cannot hope to provide themselves with tools; and their opportunity for a livelihood depends on their use of the tools of others, under equitable terms. Thus it is asserted that workers have an inherent claim on the tools of industry, the instrumentalities of production; and that arbitrament between this claim and what has hitherto been called the ownership claim is a function of government. The so-called "free compact between free men" is, according to this philosophy, a specious phrase, for the parties to the compact are never equally free.

With mandatory collective bargaining and the prohibition of discrimination, one would think labor had made a tremendous stride, but this seems not to be enough. Labor demands that unions bargain collectively not merely for their members, but for the whole employed group. Or, as alternative strategy, it seeks to exclude nonmembers of unions from the employed group. Thus, if organized labor has its way, the nonunion worker must join the union or starve. And employers must in fact reach an agreement with their then existing groups of workers, or go out of business, as a few of them have done here and there.

All of our sympathies are with the worker seeking to better his condition, in or out of a union. But the aim of organized labor, now, is despotic control. Not only its aim but its present methods are despotic. The phrase "peaceful picketing" has often become a contradiction in terms. Perhaps we had despotism before. I do not want to see it replaced by another form. I am against any form of despotism.

We are heading toward a dual hierarchy—the old one of employers, stockholders, managers, financiers; and a new one of union leaders, many of them intelligent, capable, resourceful, amply informed; but few of the men who ever had "to meet a payroll." The worker of tomorrow will thus serve two masters. And, as the battle lines are drawn, one of these masters is utterly indifferent to the one thing that can basically and permanently improve the worker's position—increased productiveness of the whole productive system.

It seems to me that all of this is essentially a matter of lifting ourselves by our bootstraps. We are trying to take out of the box more than there is in it.

Strikers occupy the premises in which they were employed, prevent access and egress, interfere with the service of the United States mail, trespass on and deface or destroy (so it is said) the property of others, all without a shadow of right and in many cases without any apprehension of interference by those public officials who are sworn to maintain law and order. No national peril can compare with that which arises when any group—employers or employed—can with impunity defy the lawfully expressed will of the majority.

Many assume, therefore, that "majority rule" is the only essential in self-government. The truth is that mere majority rule and freedom are incompatible. We see this in Germany and in Italy. (It is perhaps less certain that in Russia the elements in control have ever had anything approaching a free popular mandate.) None of us, I dare say, would be willing to live under the absolute domination of a majority. This would constitute the most extreme form of social insecurity. And the exercise of the delegated authority of a mere majority, without constitutional restraints, leads inevitably to what we now see in Germany and Italy.

Under majority rule, in this country, the Democratic winners in 1933 might have put all the Republican losers in jail; or, in 1937, might, literally as well as figuratively, have pilloried the economic royalists.

A CONSTITUTION

What prevents such actions? Constitutional provisions providing for free speech and a free press, and for due process of law; and (perhaps I should add) those prohibiting cruel and unusual punishments.

The principle back of all this is that there are certain inalienable rights (life, liberty, and private property, for example) with which no majority may wilfully interfere. Such rights are not subject to the will of the majority. This was the compact under which our government was established. We may change the compact, by methods prescribed in the original instrument, but not otherwise.

Someone may interject that Great Britain has no written constitution. But certain basic principles, never lightly violated by a sober people with whom tradition is strong, make up what is described as the British constitution. It provides, for example, for a king, lords, and commons. The regency under George III, the curbing of the power of the lords some 35 years ago, the abdication of Edward VIII—these were legislative or ministerial acts taken only after an overwhelming popular mandate, expressed or implied. Our plan provides that the mandate be expressed, and defines the term "overwhelming." Moreover, with us, a precise issue must be laid before the people.

Our own Revolution was in large part the result of what we and many Englishmen deemed to be the exercise by the British ministry and Parliament of powers not constitutionally theirs.

Our Constitution limits and defines the lawmaking powers of the Congress and of the state legislatures. Experience has shown that these bodies occasionally overstep the powers granted them. In some countries of Europe, when it appears that a legislature has exceeded its powers, nothing can be done; the legislature itself is the sole judge in the matter. Do we wish to introduce the European system here? Our Congress has had little experience in self-control in this respect. Its more recent tradition has been to legislate, leaving the matter of constitutional prerogative to others, for assertion and determination. Recently the Congress has actually been urged by the executive to enact a law regardless of doubts which members might have of its constitutionality.

The type of federal income tax which exists here was thought by many to be prohibited by our original Constitution (Art. I, Secs. 8, 9). Yet a Congress levied such a tax. It was declared unconstitutional and thus thrown out. A long time then elapsed before a preponderant majority could be obtained for the amendment of the Constitution and the enactment of the desired type of law.

It took a rather long time, also, to secure the prohibition amendment because the preponderant majority was at first averse to federal prohibition. Only a few months were required for the amendment which repealed prohibition. The people then really wanted repeal.

For several years there has been pending a child-labor amendment. We conclude that the popular will, as expressed by methods which are constitutionally prescribed, does not as yet strongly favor federal control of child labor.

Those who now propose constitutional revision offer no specific amendments for discussion. They avoid clear-cut issues. They prefer to have us vote on motives and ideology. In other words, they ask for a blanket grant of power. Some of them wish, not to amend, but to subvert. What they and others really want is the elimination of constitutional protection of private property.

Federalism, now so firmly in the saddle, is its very self the result of a deliberate departure from majority rule. The senators from Idaho and Nevada, representing 536,000 people, have equal voting power with those representing the 22,000,000 people of New York and Pennsylvania.

So far are we from being a pure democracy that not even the unanimous vote of 46 of the other states (99$^{1}/_{2}$ per cent of our total population) could change this (Art. V). Idaho and Nevada are rather restless states. Would they like to alter this present scheme of things?

A majority of qualified voters should rule, of course; but (equally of course) within limits which are set to preserve inalienable rights of individuals and minorities. In our experience, these limits have been matters of record, and the determination of when these limits have been exceeded has been left to an impartial third arm of government, the judiciary.

ECONOMIC PLANNING

Some visualize an order of things in which there will be a centralized coordinating body which will determine what shall be produced, where, and when, who shall be employed and how, in all the fields of gainful activity. This is the antithesis of *laisser faire*.

We have had a bastard type of economic planning recently, on a limited scale, because confined to specific fields. The coordinating agency was government. Under *laisser faire*, if too much wheat were grown, those who produced wheat were put at an economic disadvantage. Then there was an automatic pressure toward diminished wheat crops and a reduction of personnel engaged in growing wheat. This pressure tended to correct the evil which caused it. Now the government, using various devices, seeks to curtail excess agricultural production by positive rather than automatic means; by crop limitation paid for with loans and bounties. It interferes with the natural regulatory forces and substitutes artificial regulation. Most of the measures merely tax the general public in order to benefit the wheat-growing class, and cannot do more than that. Any economic planning short of that which is universal is bound to lead to just such results. It can help groups, but only at the expense of the aggregate. It tends to perpetuate the unbalanced condition which causes all the trouble.

And universal economic planning under governmental control is regimentation. We had a slight taste of it during the World War—enough to show us the supreme difficulty of the job. Before we entrust new functions to government—productive functions—may we not hope first for a demonstration of governmental competence and effectiveness? If government were already doing unusually well what it now has to do, then—but not until then—it would be safe to contemplate so novel an expansion of its powers.

These are the elements of what seems to me to be a dangerous situation—one which may prove to be tragic. An optimist in habit and from conviction, I must yet admit that the facts now visible afford, for the moment, little basis for persistent hopefulness.

BRIEFING THE RECORD

Abstracts and Comments Based on Current Periodicals and Events

MATERIAL for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

Day by Day

PERSONALITIES bulked large in the day-by-day news of interest to engineers as represented in odd bits from publications and the mail.

TOWNE

A painted portrait of Henry R. Towne, past-president and honorary member, A.S.M.E., one of the founders of Yale and Towne Manufacturing Company, and one of the principal founders of the New York Museum of Science and Industry, was unveiled on Nov. 5, 1937, at the Museum, located at Rockefeller Center, New York, N. Y., in connection with a new exhibit, the History of Locks. The portrait was unveiled by a great granddaughter, in the presence of John H. Towne, a son of the founder.

VAUCLAIN

At Philadelphia, Pa., on Oct. 5, 1937, at a luncheon given in his honor, Samuel Vauclain, chairman of the board, the Baldwin Locomotive Works, honorary member, A.S.M.E., addressed the American branch of The Newcomen Society of England on "Mass Production Within One Lifetime." He referred to the address by J. W. Roe, "Interchangeable Manufacture," published in MECHANICAL ENGINEERING for October, 1937, and spoke in a delightfully reminiscent vein of incidents in his long career. His first application of "mass production" was in shelling corn by means of "an easy device which consisted of an ordinary garden spade laid flat on the edge of the tub with the handle resting on the floor. Straddling the spade I drew the ear of corn across its edge, which resulted in all the others retiring and leaving the matter of shelling corn entirely up to me. Quantity or mass production, or whatever you may see fit to call it, was accomplished by a device, simple in itself, and very easy to operate. It was my first device to save labor, shorten time, produce in quantity. My success in this endeavor caused me to approach any task allotted to me with a determination to shorten time, improve quality, and reduce cost. Mass production," he concluded, "has invaded every industry, every occupation of mankind, and has put this nation upon the highest level of prosperity, far in excess of any nation in this troublesome world . . . I am still 'shelling corn.'"

HONORED

The American Society of Civil Engineers elected to honorary membership Otis E. Hovey, eminent designer of bridges, authority on movable bridges, director of the Engineering Foundation, and member A.S.M.E. Early in November Mr. Hovey began a series of visits to research projects sponsored by the Engineering Foundation.

To Paul Dyer Merica, director of research of the International Nickel Company and vice-president, the International Nickel Company of Canada, has been awarded the 1938 John Fritz Gold Medal, highest of American engineering honors, for "important contributions to the development of alloys for industrial uses." The award is made annually for notable scientific or industrial achievement by a board composed of representatives of the A.S.C.E., A.I.M.E., A.S.M.E., and A.I.E.E.

Alumni membership in the Cornell chapter of the Society of the Sigma Xi was conferred on Edward Bausch, chairman of the Board, Bausch and Lomb Optical Company, and 1936 A.S.M.E. Medalist, whose contributions to optics and the optical industry have extended over 60 years.

For his vision, inspirational guidance, and aggressive cooperation in the advancement of the acetylene industry, H. Sidney Smith, consulting engineer of the Union Carbide Company, member, A.S.M.E., has been awarded the James Turner Morehead medal of the International Acetylene Association.

In recognition of his work in abstracting technical and scientific writings in all fields of the chemical industry, E. J. Crane, editor of *Chemical Abstracts* since 1914 (from 1911 to 1914 he was associate editor) has been awarded the Chemical Industry Medal for 1937. More than 60,000 abstracts are now published annually under Mr. Crane's editorship.

The 1938 William H. Perkin medal of the American section of the Society of Chemical Industry has been awarded to Frank J. Tone, president, Carborundum Company, for valuable work in applied chemistry, including the development of abrasives and refractories. The presentation is to be made on Jan. 7, 1938.

Presentation of the Lincoln Gold Medal to T. M. Jackson, chief engineer and welding engineer, Sun Shipbuilding and Dry Dock Company, for his paper "Welding in Tanker Construction," took place at the 1937 annual meeting and welding exposition of the American Welding Society, Atlantic City, N. J., Oct. 18, 1937.

In recognition of 50 years of service to the City of New York, Charles S. Tuttle, past-president, A.S.C.E., president, Engineers' Club of New York, and former chief engineer of the Board of Estimate of the City of New York, was presented, on Nov. 3, with a distinguished-service certificate by Mayor La Guardia.

FLANDERS

On October 25 Ralph E. Flanders, past-president, A.S.M.E., as one of a committee of the Business Advisory Council, is reported by the press to have called upon President Roosevelt. W. Averill Harriman headed the committee, whose other members were Morris Leeds, of Philadelphia, and Clarence Francis, of New York. The purpose of the visit is said to have been to invite the President to dine with the council.

The Business Advisory Council was created by Secretary Roper in 1933 as a group of representative business men to assist in directing the work of the Department of Commerce and to develop a long-range plan to give direction to business, says the *New York Times*. It later developed into the President's advisory council. Originally made up of 52, it now has 57 members. The council meets every six weeks in Washington and usually is in session two days. Its studies and reports have included social security, extension of NRA, air safety, lighter-than-air craft, foreign trade, simplification of patent procedure, merchant marine, administration of relief, agriculture, general taxation, housing, relocation of industries, elimination of unfair trade practices, and creation of a permanent economic council.

ISHERWOOD

At London, on October 25, Sir Joseph William Isherwood, naval architect, died at the age of 67. Isherwood devised the longitudinal system of framing ships. In this system the plating of the shell and deck is supported by continuous longitudinals which pass through the transverses, set at intervals of about 10 ft, but are cut at the bulkheads to which they are bracketed. In tankers the middle line and transverse bulkheads are also stiffened by longitudinal members, so that each longitudinal is a continuous horizontal girder around the tank. In cargo vessels the system has been introduced so that the framing at the bottom and deck is longitudinal, while ordinary framing is retained at the ship's side. Isherwood later introduced the bracketless system in which the brackets at the bulkheads are dispensed with, the spacing of the transverses is rearranged, and doubling is resorted to for strengthening the shell and deck plating near the bulkheads. In 1932 the "arcform" system was developed by Isherwood, permitting an increase in cargo capacity for a given displacement and a reduction in fuel costs.

RUTHERFORD

At Cambridge, England, on October 19, Lord Ernest Rutherford, director of the Cavendish Laboratory since 1919, and winner of the Nobel prize for chemistry in 1908, died at the age of 66. Hailed as the greatest experimental physicist since Faraday, he was buried on October 25 at Westminster Abbey, his ashes being placed in the science corner where Newton, Faraday, Darwin, and Kelvin are interred

Lord Rutherford was born in New Zealand and there received his early education. At Trinity College, Cambridge, he began his research work under Sir J. J. Thomson. His early work in the conduction of electricity through gases and the nature of radioactive transformations led to studies of the nuclear nature of the atom and the electrical structure of matter, the key to atomic physics. A thin volume, published in 1937, based on the Henry Sidgwick Memorial Lecture delivered at Newnham College, Cambridge, November, 1936, entitled "The Newer Alchemy," is an extremely illuminating and readable summary of present knowledge of transmutation and what is popularly termed "atom smashing."

In various parts of the world scientists are engaged on the problems to which Lord Rutherford gave so much of his attention, and even the research departments of large industrial establishments are exploring the subject. What commercial results the future holds are unpredictable. Lord Rutherford, in the book referred to, said that the atomic nucleus is a world of its own in which a number of particles like protons and neutrons are confined in a minute volume and held together by very powerful unknown forces. Vigorous attempts are now in progress, he continued, to adapt existing ideas to explain the structure of atomic nuclei and some success has been gained in a few simple cases. We are, however, still far from understanding the structure of a complex nucleus and the reason why it breaks up under certain conditions.

GARVAN

In New York City, on November 7, Francis P. Garvan, president, Chemical Foundation, Inc., and former U. S. Alien Property Custodian, died at the age of 62. A lawyer by profession, Mr. Garvan possessed the vision and the opportunity to organize, in 1919, the Chemical Foundation to acquire foreign chemical patents and trademarks, largely German, seized by the government during the War. For his services to the chemical industry he was awarded the Priestly medal of the American Chemical Society in 1929, and was acclaimed as the layman who had done most for the advancement of chemistry. In the agricultural industry he realized the vast resource of materials available over and above the nation's food supply, and to this movement he devoted much of his time. He is said to have attributed the ability of the chemical industry to offer improved products at lower prices to the directors of the industry who have attained the command and use of scientific habits of thought.

EDUCATION

Henry C. Anderson, member, A.S.M.E., has been appointed dean of the college of engineering, University of Michigan, to succeed Herbert Charles Sadler, resigned.

Two members of the A.S.M.E. have recently been appointed to the Board of Trustees of the Case School of Applied Science. They are Philip E. Bliss, president, Warner and Swasey Company, and Alexander C. Brown, first vice-president, Cleveland Cliffs Iron Company.

The Board of Trustees of Cornell University has appointed S. C. Hollister, member, A.S.M.E., dean of the college of engineering.

A cooperative educational enterprise which will link the Westinghouse Electric and Manufacturing Company and the Carnegie Institute of Technology in a new program of undergraduate engineering training has been announced by President Robert E. Doherty, of Carnegie Tech. To make this project possible, and in recognition of other educational services which are being rendered by Carnegie Tech, the Westinghouse Company has appropriated $200,000 to the Carnegie Institute of Technology. The new cooperative program, which will go into effect at the beginning of the next school year, will make it possible for a number of students with superior qualifications to take the usual technical courses for a degree at Tech and, during the same period, to get both extensive shop and engineering experience and training in the Westinghouse plant.

Of the group of students who will be selected to follow the cooperative course, a number, perhaps ten each year, will receive George Westinghouse Scholarships. A George Westinghouse Professorship of Engineering will also be established, and one of the duties of the holder of this position will be the supervision of the cooperative program. The Westinghouse appropriation is the largest made thus far to the 1946 endowment fund. In June Carnegie Tech started a drive to raise $4,000,000, one third of which may be in buildings. If this sum is raised, the Carnegie Corporation of New York will double it, giving $8,000,000 in 1946, thus increasing the endowment of Tech by $12,000,000. This adds an additional $400,000 for general endowments. This is the second cooperative educational enterprise which Westinghouse has entered into in the city. There has been in effect an agreement between the company and the University of Pittsburgh providing for a cooperative program of graduate work. Undergraduate programs similar to the one to be introduced at Carnegie Tech are in operation at several institutions, notably at the University of Cincinnati and at the Massachusetts Institute of Technology. The experience of these institutions served as guidance for the framers of the Tech plan.

DEDICATION

On October 15, at College Park, Maryland, the Eastern Experiment Station of the United States Bureau of Mines was dedicated. The American Society of Mechanical Engineers was represented at the dedication by A. G. Christie, of The Johns Hopkins University. The station, of colonial type of architecture, consists of a main building approximately 53 by 114 ft, having three stories, basement, and attic, and north and south wings 50 by 113 ft each, having two stories, basement, and attic. It will be used for conducting scientific and technologic investigations concerning mining and the preparation of mineral substances with a view to the increase of health, safety, and efficiency in the mineral industries and to conserve resources through the prevention of waste. Problems of mineral producers in the eastern states will receive special attention. Rudolph Kudlich is the superintendent of the station.

AERONAUTICS

In the official bulletin of the Zeppelin Works, according to a report in the press, Hugo Eckener says that the problem of using helium in Zeppelins has been solved. The solution is said to lie in the prewarming of the gas cells to obtain greater bouyancy at the start of a flight and to avoid loss of gas when the airship reaches a cruising altitude. By capturing and condensing moisture from the exhaust of the engines the decreasing weight of fuel used up in flight will be offset, so that the necessity of valving the helium will be reduced.

Heretofore known as XMF1, the new army fighting plane made by the Bell Aircraft Company has been named the *Aircuda*, and has been delivered to the Army. Newspaper reports of the plane say that guns that "look like three pounders" are mounted on the two front fuselage sections. Lawrence D. Bell, president of the Bell Aircraft Corporation, refused to discuss the plane's armament, but did not deny that the guns are the largest ever mounted in any plane. The plane was flown to Wright Field for test.

On October 26 the *Lieutenant de Vaisseau de Paris*, largest French seaplane, ended a 34 hr 38-min flight from Port Lyautey, French Morocco, to Maceio, Brazil. The total distance of 3435.3 miles set a new long-distance flight record for seaplanes. The aircraft is said to accommodate 75 passengers and has a crew of six. On Nov. 1 a return trip was flown from Natal, Brazil, to Dakar, Senegal, French West Africa, a distance of 1830 miles, in 17 hr 55 min.

A United Press dispatch from London says that British and French military experts are cooperating in tests of television broadcasts from the air at the R.A.F. aerodrome at Hendon. It is said that the broadcasting plane controls a television camera which takes aerial photographs of enemy positions and simultaneously throws them on a screen behind the lines.

CRUISER

The *Journal of Commerce* reports that an experimental hull for a motor cruiser is to be built by Swan, Hunter, and Wigham, Newcastle-on-Tyne, from a design by F. Gordon Pratt. Tank model tests of the hull are said to indicate that a speed of 40 knots could be obtained with an Atlantic liner of similar design. It is said that skin friction of the hull is reduced and that the stern does not sink as speed increases.

GASOLINE

From Hamburg through the *New York Times* comes a statement attributed to Friedrich Bergius to the effect that Germany will soon be able to supply all her own needs in gasoline and fuel oil synthetically. It is said that calculations show that only 3 to 4 per cent of Germany's annual coal output will be needed to supply her gasoline requirements.

AXLES

On October 25, J. J. Pelley, president, Association of American Railroads, announced that early in November the Division of Engineering Research, of which L. W. Wallace, member, A.S.M.E., is director, will undertake research to determine what further improvements can be made in the method of manufacturing axles used on locomotives and freight and passenger cars. Several hundred axles of various kinds and sizes will be put through every possible test. The work, which will be conducted on testing machines at the Timken Roller Bearing Co., described in a paper presented at the 1937 Semi-Annual Meeting of the A.S.M.E., and published in the Transactions for 1937, pages 225 to 238, will be under the direction of a committee of mechanical officials of various railroads and axle manufacturers cooperating with Mr. Wallace. In this connection attention is called to the paper by R. Eksergian, "The Design of Railway Axles and Locomotive Crankpins" to be presented at the 1937 Annual Meeting of the A.S.M.E.

AUTOMOBILES

Various classes of persons took advantage of the annual automobile show at the Grand Central Palace in New York, and on the whole each class got out of it what concerned it most. The general public wanted a spectacle and thanks to the showmanship of the exhibitors the spectacle was worth while. Those with cash or hopes of cash in their pockets and an old car in the garage went as buyers, intent on selection. They sat behind the wheel, fingered the new gadgets, listened to explanations of features for which the advertising departments had invented impressive but sometimes confusing names, and came back to their favorite car to talk about terms and deliveries. The mechanically inclined lingered around stripped chassis and cutaway exhibits, inspected the new features of frame, transmission, and engine, and took in details and refinements. Forecasters of industrial conditions and feelers of the economic pulse, groggy with rapidly declining stock-market prices and gravely alarmed over a business recession several months in progress and the almost nonexistence of capital seeking useful employment, noted the size of the crowds and orders, hopeful that the automobile industry might again reverse the downward trend of economic activity.

Kettering, who is given to saying things that are long-remembered, claims that no one ever stumbled while standing still. The automobile industry proves his point, for it never stands still, and if it stumbles it soon rights itself. Perhaps some of the gadgets and developments that attract visitors at automobile shows may be cases of stumbling. At least they indicate no tendency to stand still, and time and the public soon eliminate the innovations that are doomed to failure. Driven by necessity and the tradition of the industry to try new things and to test them first as best they can before offering them to the public, the automobile manufacturers always have something novel to offer, with the net result of improving their product from year to year. Noteworthy this year was attention given to transmissions and gear shifts. Numerous schemes are offered, practically all of which have resulted in removing the gear-shift lever from its accustomed place at the driver's right. The dash and the steering column are now used in place of the floor, and with the brake under the dash, more leg room is available in the front seat. To manual devices are added electric, hydraulic, and pneumatic schemes, automatic and semiautomatic in action. The situation is reminiscent of the early days of the self-starter when springs, compressed air, acetylene, and electric motors were tried in accordance with the convictions of the designer as to the best system. Coil springs for the rear axle have appeared, shock absorbers of a new type, stabilizing devices for front and rear suspensions, and a host of refinements too numerous to mention. In this connection the reader is referred to the November issue of the *S.A.E. Journal* in which Austin M. Wolf presents a comprehensive summary of the outstanding features of 1938 models.

Great interest was displayed in safety exhibits, and safety was strongly advertised by all manufacturers. It is typical of the realism of automobile designers that safety is a major consideration with them, rivaling performance, comfort, and appearance in their product and efficiency in production.

Trailers, too, showed development and great diversity in size, convenience, price, and taste in appointment. These fascinating examples of compactness rival in interest the cruiser cabins through which endless lines of visitors curiously file at the motorboat show. They charm the housekeeper and tempt the wanderer, and seek to create the illusion of a home by the incorporation of that oldest and most essential mark of a home, the fireplace—of all things! Trailer supplies and equipment, too, abound and fascinate—highly colored unbreakable dishes, nesting pots and pans, electric generating sets that can almost be carried about in an overcoat pocket—everything has been thought of and provided.

Aside from the technical and novel features of the automobile show, what interests the country most is the immediate economic future of the industry. Attendance at the show was probably not equal to that of a year ago. Sales were reported good and many exhibitors gave optimistic reports to the press. An early start on production scheduled in many plants is being reflected at present in sharp sales gains. Some observers are uncertain as to the duration of the trend. A general business recession is in progress and labor troubles are not yet over. The Federal Farm Bureau forecast on the economic situation said in reference to the automobile industry that a large potential demand for cars still exists, but called attention to the fact that replacements can be postponed. The reported relatively minor changes in new models, it continued, the higher prices to be asked, the expected more stringent terms for financing new and used cars, and the change in direction of stock prices and incomes may result in a smaller replacement than in 1937.

Against the drab background of falling indexes and in contrast to the fantastic generalities of those who create the impression that the country can enjoy security and plenty without hard work and greater productivity, the leaders and engineers of the automotive industry inspire confidence and hope. They combine realism with creative ability and technical competence and go about attaining their objectives in spite of the obstacles and limitations thrown in their way. One came away from the General Motors luncheon to editors of the technical press and the automobile show refreshed by the atmosphere of productive realism in which modest, hard-working, and competent men live and through whose creative leadership such large numbers of the nation's families exist. One could wish that this atmosphere might pervade the entire country and drive out the envy, covetousness, petty hatreds, mental inertia, and desire for slothful ease and unearned security that threaten social and economic well-being.

Engineer of Tomorrow

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION

IN A paper entitled "The Rôle of the Engineer of Tomorrow," presented at the 1937 annual meeting of the Society for the Promotion of Engineering Education, V. M. Faires, member, A.S.M.E., contends that we are rapidly approaching an era when those who "manage civilization" must have a background of science, and when scientists must have a background of the "stuff that makes good managers and governors." At present, he asserts, engineers in general are not prepared to rule the country because they have not been trained in those elements which produce great men of public affairs. Technological civilization, therefore, is faced with the dilemma of statesmen untrained in technology and of technologists untrained in statesmanship. The future status of engineering, he continues, is predicated upon a changing society resulting from elements of instability in the present form of society and upon society's indubitable dependence upon the knowledge of professional men.

Although we are conscious of living in a changing world, he argues, we are likely to think of the changes as being merely physical. More subtle and significant, however, are the subsurface changes in the basic conceptions of society, those unseen transformations in the ideas and manners of the people who are actuated by the more obvious material changes.

Glancing back over history, Mr. Faires observes that in previous eras of development, social ideals were not the same as ours of today. These former eras had their characteristics and their problems, and the introduction of the machine provided conditions and problems with which society is concerned today. In so far as the instability of the modern social order is concerned, a number of factors are present today which were substantially unimportant a century ago. Among these are a more common enjoyment of luxury goods, an increasing significance of fixed charges as an element in the cost of production, and the urbanization of a larger proportion of the population.

Mr. Faires then asks, What is there in modern society which distinguishes it from social organisms that have preceded it and that may yield a clue to the nature of our future development? The most distinguishing factor he finds to be science. One of the consequential products of science, he asserts, is the machine. The effects of the machine on science, he observes, have been aggravated by two factors: (1) A more comprehensive use of mechanical and electrical power; and (2) a more general utilization of the principles of "scientific" management. The findings of science are made useful to society by professional men, and while we should not expect professional men to displace the politician, we may anticipate that the politician will be forced by circumstances to place a greater dependence on the expert.

Certainly, he continues, engineering is not the least important of the professions. Certainly, no professional class will have a more significant rôle than the engineering group. No matter what may be the ultimate outcome of the contemporary evolution of society, the engineer will emerge as something of a keystone of the new structure. He will naturally be in demand for his technical skill. But the engineer is not prepared now to administer the will of the people. Society needs, not just engineers, not engineers who have only shed the careless empiricisms of yesterday, but engineers with the power of comprehending the social order, with the power of understanding the social implications of the machine. Society needs engineers with the power of seeing, not just an individual, but the individual and all his environment together. In justification of present curricula in engineering schools, we often hear it said that industry is satisfied with our product. But to satisfy industry is not our sole obligation. We must—and this is fundamentally more important—we must satisfy society as well. If the engineer is able for his part to contribute only a technical skill, he will fall far short of society's expectations and demands. Educators of engineers must somehow impart to students an uncommon flexibility of mind, an eagerness to pry under the surface of life, a feel for the current of civilization.

Something About Life

SCIENCE

IT IS commonly assumed, says N. V. Sidgwick, of Lincoln College, University of Oxford, in an address entitled "Molecules," delivered at Denver, June 23, 1937, and published in *Science* for Oct. 15, 1937, that chemistry, like physics, can prevail everywhere, but on inquiry it can be readily seen that this is by no means so; it is only under rather exceptional conditions that chemical processes can occur.

Chemistry is commonly called molecular physics; it is the investigation of the structure and behavior of those little groups of atoms which we call molecules, whose almost infinite repetition constitutes the chemical substances of our ordinary experience. The first point is to know what molecules are, and in general terms, why they are formed.

The matter of the universe consists of atoms, of some 90 to 95 different elements. Each atom is made up of a small positively charged nucleus, surrounded by a number of electrons equal to the number of units of positive charge on the nucleus. Now the electrons surrounding a nucleus can arrange themselves in groups of greater or less stability, and it often happens that two or more atoms can make a more stable arrangement of their electrons by pooling them or by transferring some of them from one atom to the other. If the extra stability so gained is great enough, the atoms will remain attached to one another, and a molecule will have been formed. It is only a few of the outermost electrons of any atom which take part in these rearrangements—the greater number are already sorted out into groups—and in consequence the number of atoms which form a molecule is never large, often only two or three, and rarely more than a hundred.

Chemistry can only occur where there are molecules, and chemical processes can only occur where these molecules react with one another. This imposes definite limits on the sphere of chemistry, limits which in a sense are surprisingly narrow. Throughout the universe the temperature varies widely, from a very few—say two or three—degrees above the absolute zero in empty space, or in very old or very small stars such as the moon, up to several millions (even hundreds of millions according to some physicists) of degrees in the center of large stars like the sun.

Our knowledge of the composition of the stars (and much of our knowledge of their temperatures, too) is derived from the study of their spectra. From these investigations it appears that in the sun's atmosphere with a temperature in the parts we can see of about 6000 deg abs, there are practically no molecules at all. We may therefore take this temperature of 6000 deg abs as being the highest temperartur at which chemistry can exist. This is nearly twice the temperature of the electric arc, which is the highest temperature that we can produce artificially in any considerable space. At any temperature lower than this we shall find molecules existing wherever there is matter.

But at these low temperatures, say at the boiling point of liquid air—180 C or 100 abs—though there must be plenty of molecules, there will be very little chemistry. Chemistry implies not only the existence but also the reactions and interconversions of molecules, and we can show that at such low temperatures the great majority of molecules do not react.

It is therefore evident from our observation of the behavior of matter that the scope of chemistry in the universe is strictly limited; it can exist only where it is neither too hot nor too cold. Moreover, these limits are fairly narrow.

It is quite clear that without chemistry there can be no life. Even the simplest of living organisms are made up of molecules of great complexity, and their life depends on the occurrence of chemical changes among these molecules. Living organisms can endure very diverse conditions, but the limits between which molecules can exist and react are final. It is only within them that life can be carried on.

Professor Sidgwick then shows why molecules are all destroyed above 6000 deg and cease for practical purposes to react below 100 deg, and proceeds to an explanation of the conditions under which life is possible, as quoted in what follows.

If we really want to know under what conditions life can exist, we must not pay too much attention to the forms of life which we know on earth, but must consider whether other forms of life may be possible, and whether there may be other conditions under which life can develop. As far as we can see, the existence in any material form of life, including in that term animals, that is, organisms which can move about freely requires four things: (1) Organized living matter; (2) an external source of energy; (3) some unorganized and probably inorganic substance in the surroundings which can react with the living matter and give it the necessary energy; and (4) what may be called a lubricant, some probably inorganic substance liquid at the temperature of the animals, which makes their motions and their reactions possible. We may consider these four factors separately:

(1) *The Organized Living Matter.* The material basis of all the forms of living matter that we know is a series of compounds of carbon. We have first to consider whether there is any other element that might take the place of carbon. There is only one that has ever been suggested as possibly capable of replacing carbon in living matter, and that is silicon. It has, however, been evident for some time that even silicon has not the properties which such an element needs. This makes our inquiry more precise, because we know something about the range of stability of carbon compounds, and the possibility of some entirely different material being employed is excluded.

(2) *The External Source of Energy.* If our animals are to do anything, they must acquire energy from somewhere. How this is done on the earth is familiar to all of us. The ultimate source of the energy is the sun's radiation, which enables plants to build up compounds of carbon from water and the carbon dioxide of the atmosphere; these compounds are eaten by animals, and in their bodies combine with the oxygen of the air, being reconverted into water and carbon dioxide and in the process liberating energy for the use of the animals. It is difficult to see what other method there can be which is anything like as convenient. The animals must have some external source of energy. Any chemical source, from the chemical combination of the unorganized world surrounding them, would very soon be used up, and the only steady source of supply we can imagine is the radiation from a star. If this is to be used, the living organism which is to absorb and trans-

form it must have a very large surface in comparison with its mass. These are very unsuitable proportions for a creature that is to move about freely, which should be compact. Hence it is an obvious economy to separate the two functions: to have one kind of machine, which need not move about, with a large surface to absorb the radiant energy, and another which is adapted for motion but not for the absorption of radiant energy and which gets its energy by consuming the products of the first kind and reconverting them into the material of lower energy from which they were formed by the help of the radiation. The source of radiant energy will be the radiation from a hot star, which implies that the life must be confined in the main to the outside of the planet on which it occurs, and also that there must be in its neighborhood a hot star big enough and hot enough to supply the necessary radiation. This will normally be the star to whose system the planet belongs.

(3) *The Energy Carrier.* The animal must have access to some substance which can combine with the product of the plant with the liberation of energy. It is difficult to think of anything which could replace oxygen for this purpose. It must be a substance which can exist in the gaseous or liquid surroundings of the organism and will not all combine with the solids. The only materials which meet these requirements are the gaseous elements and their volatile compounds, and the latter, such as water or ammonia, have not enough energy for the purpose. We are thus confined to oxygen, for nitrogen is far too inert.

(4) *The Lubricant.* It is fairly obvious that life cannot be carried on by creatures entirely composed of dry solids. Chemical reactions scarcely occur in solids, and as we all know mechanical operations are impossible without a lubricant. Hence the world where life is to be possible must contain a liquid which can interpenetrate the living matter. We can further see that the substance must be one which is liquid at the temperature of our living system, that is, at temperatures which are not too high for the complicated organic compounds of living matter to exist. Practically the only common substances which will satisfy all these requirements are the lower hydrocarbons like methane and ethane, ammonia, and water. The hydrocarbons are much too inactive; the atmosphere in which our animals live must contain oxygen, and this would rapidly burn up the ammonia to nitrogen and water. Hence the only available liquid which will support the activities of living creatures is water. So, the temperature limits of life on earth must be valid for life of any kind anywhere; the temperature must lie between limits which are only slightly outside the melting and boiling points of water.

To sum up, it would seem that life will be mainly confined to the surface of the planet on which it occurs, owing to the necessity of its receiving radiant energy. This planet must not be too small or the atmosphere will be lost, as has happened on the moon. On the other hand, it must not be too large: if its atmosphere is too dense, the radiation from which the life derives its energy will be cut off by the upper layers, and not enough will reach the surface, where practically all the living organisms must be. The prevalent temperature must be on the average between the boiling and the freezing points of water, though a slight excess or defect beyond these limits is possible. This is of course the most serious limitation of all. The freezing point of water is 273 deg abs; the boiling point depends on the atmospheric pressure, but as we must not have too dense an atmosphere we shall be safe if we say that the boiling point will not lie above 500 deg abs (227 C), which is its value under 27 atmospheres pressure. This gives us a temperature range of only 500–300.

As far as the familiar planets of our own system are concerned, the conclusions only confirm the views that have long been held. The moon is much too small for life to be possible; Mercury is probably too small and too hot; Jupiter and the outer planets are too cold. The only places in the solar system where life is possible seem to be the earth and our two neighbors, Mars and Venus.

Wage Incentives

FACTORY MANAGEMENT AND MAINTENANCE

BECAUSE for three years he had been asked about wage incentives, L. C. Morrow conducted a survey on the subject in which 133 plants, representing pretty much all types of manufacturing, cooperated. In the October issue of *Factory Management and Maintenance*, which Mr. Morrow serves as editor, the results of the survey are presented.

Approximation of the statistics Mr. Morrow turned up are as follows:

46 per cent of the 133 plants are paying 47 per cent of their employees on a straight piecework basis.

46 per cent are paying 46 per cent of their employees on the individual-bonus basis.

35 per cent are paying 29 per cent of their employees on the group-bonus basis.

7 per cent are using measured daywork to determine the earnings of 52 per cent of their employees.

86 per cent are paying 45 per cent of their employees on a straight day-work basis.

52 per cent of the 124 plants now using incentive payment systems are increasing their use; 3 per cent are decreasing their use; and 44 per cent are neither increasing nor decreasing their use.

32 per cent of the 103 plants which have reached conclusions one way or the other say they believe their present incentive systems should be simplified; 68 per cent say that present systems are simple enough.

32 per cent of the 128 plants which report that they have or have not discussed wage incentives with unions say they have; 68 per cent say they have not.

10 per cent of the 116 plants reporting on measured daywork say they are considering its adoption; 90 per cent say they are not.

44 per cent of the 120 plants willing to take a stand say they believe an incentive system should recognize personal qualifications such as dependability, versatility, and length of service; 56 per cent say they believe it should not.

The cooperating plants were asked to tell why they believe their present incentive systems should or should not be simplified. On the part of those advocating simplification there was a fair number of scattered reasons but a heavy majority said, in effect, "For better understanding of a computation by employees."

For not advocating simplification, the reason most frequently advanced was: "We use straight piecework, and that is the simplest system " Other reasons included: "Simplification implies compromising with accuracy;" "system successful for over 10 (or 16, or 25) years;" "simpler system would not adequately measure our complicated operations;" "it is liked by majority of workers and is supported by the union."

In answer to the question, What has been the union attitude toward wage-incentive systems? Mr. Morrow gives 47 replies, of which 30 were favorable, 13 unfavorable, and 4 uncritical.

No uniformity of opinion is found in about 50 quoted answers to the question, What advantages do you see in measured daywork? The answers, however, are illuminating.

The final question, What assurance have you that your operators understand your present incentive systems and have complete confidence in them?—brought many answers. Mr. Morrow summarizes the reasons and adds that some replies said frankly that no such assurance exists, while others admitted that complete confidence does not exist. The majority, however, Mr. Morrow concludes, feel that employee feeling is good. There is a pronounced feeling, he says, that management recognizes the importance of the question and is working to gain and merit both understanding and confidence on the part of employees.

The Mariners' Museum

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

THE Mariners' Museum, located at Newport News, Va., established by Archer Milton Huntington, is described in a paper before the 1937 annual meeting of The Society of Naval Architects and Marine Engineers by the president of the museum, Homer L. Ferguson.

Nearly a thousand acres of land, embracing Waters Creek, a tidal estuary of the James River five miles north of Newport News, were purchased by Mr. Huntington and deeded to the museum. A collection of books for a maritime library and of maritime exhibits has been inaugurated and a fireproof building erected. A shop for the making of models has been installed in which accurate scale models have been built. In addition to these models the museum exhibits include a number of small boats and canoes from various parts of the world. There is also a representative collection of ship ornaments, anchors, bronze and iron cannon and small arms, navigational instruments, ship tools, sailors' handiwork, and china, postage stamps, medals, coins, and paper money illustrating the influence of the sea. An extensive library of 18,000 items has been assembled, as well as prints of ships, battles, and ports.

A Broader Education

ELECTRICAL ENGINEERING

SPEAKING on the subject, "Engineering Education and Democracy," before the Lehigh Valley Section of the American Institute of Electrical Engineers on May 14, 1937, Robert E. Doherty, president, Carnegie Institute of Technology, considered a recommended form of engineering education intended to train engineers interested in assuming their places as effective citizens in a democratic government. The address is to be found in the September issue of *Electrical Engineering*.

President Doherty contends that educators should give to students a start toward that rounded-out education which is so essential to professional activity on a high plane and which is indispensable in placing engineers in effective leadership alongside other professional men. A concerted move toward an adjusted philosophy is indicated, if this is to be accomplished, and this must start from a premise that competent citizenship is the first responsibility and that the more the individual's educational opportunity is extended the greater is this responsibility. If this point of view is accepted, professional education must devote to this end more of the precious time to its programs, and this means either that the programs must be extended or that industry and business must be willing to accept graduates with training less specialized than they now have. President Doherty then goes on to discuss his views on the question, What would engineering education do if industry gave it a free hand? and What are the practical implications regarding the curricula?

There are two critical questions to be considered; the distribution of time between technical and social phases of the curriculum and the specific nature of the social and economic side of the program. President Doherty lists the objectives that should be sought as follows: (1) A clear historical understanding of the parallel growths of science and engineering on the one hand, and social customs, relations, and institutions on the other, and how these have reacted on each other; in other words, a historical perspective of social evolution, especially since the invention of the machine. (2) The ability to read purposefully in order to make a critical analysis of a problem involving social and economic elements and arrive at an intelligent opinion about it. The ability to analyze technical problems, does not, he wisely observes, as sometimes is assumed, imply the ability to analyze these others. (3) The ability to organize thoughts logically and with purpose. (4) The capacity to use the English language and thus express these thoughts effectively. (5) Appreciation of English literature. (6) A continuing interest in all these matters and the desire to become educated.

To whatever extent it is true, says President Doherty, that industry by insisting upon the treating of special routine skills prevents the schools from educating students along these broad lines that seem to be so clearly necessary, then to that extent it becomes the responsibility of the schools to convince industry that its position is unwise. In any case, the problem is to provide a four-year curriculum that will recognize the educational policy outlined by President Doherty and yet be a preparation for entering those fields that now employ engineering graduates.

Colored Headlights

ENGINEERING

COMMENTING upon "The Use of Coloured Lights for Motor Car Headlights," Illumination Research Technical Paper No. 20, H. M. Stationery Office, an editorial in *Engineering* for Oct. 8, 1937, quotes the practical issues involved in the form of four questions which are discussed in the report. These are: (1) Can the driver of a car at night see better if he uses headlights emitting colored light; (2) is the disturbance of a driver's vision by the headlights of other cars reduced if they use colored lights; (3) can a driver see objects at a greater distance in mist or fog if he uses headlights emitting colored lights; and (4) can the occurrence of colored objects and backgrounds be turned to advantage by using headlights emitting colored lights.

All these questions are answered in the report in the negative, although in some cases there is slight qualification.

Regarding the first question, it is said that a small advantage in the detection of contrasts of brightness is secured by the use of the yellow filter, and there is evidence also of a slight increase in the power of the eye to perceive details of a pattern in black and white resulting from the use of yellow light obtained from white light by means of a filter.

In answer to the second question the report concludes that there is no evidence that the power of the eye to perceive contrasts of brightness in the presence of a dazzling light is enhanced if similar color filters are placed over the dazzling light and over that which illuminates the object viewed. If a yellow light is used, the time which the eye takes to react in the presence of, or after exposure to, a dazzling light is slightly reduced, but the reduction only amounts to 0.03 or 0.04 sec in reaction times of the order of 0.2 sec.

One of the conclusions with respect to driving in fog states that "in conditions of slight or thick fog the range of visibility of objects seen in the beam of the headlight is not increased by the use of colored light obtained from the original white light by means of a filter."

With regard to the fourth question, it has been suggested that yellow and green tints predominate in country districts and consequently brightness contrasts would be accentuated by the use of yellow light. Actually, however, it is said, even if backgrounds were generally yellow or green, which is not admitted, the brightness contrasts would be reduced rather than increased by the use of green or yellow filters and the visibility of the pattern in the background would not be improved by the use of a filter of the same color as the background.

Pilot Injection

ENGINEERING

DIESEL knock, says D. Jafer in *Engineering* for Oct. 15, 1937, is an obstacle in the path of the general use of the high-speed solid-injection oil engine, and is probably dependent on the delay period in the combustion process. This delay period depends on the nature of the fuel and type of combustion chamber, as well as on many other factors.

For smoother running of the engine the delay period must be eliminated or made as short as possible, and two methods appear which may accomplish this end, i.e. (*a*) doping of the fuel, or increasing the compression and possibly density, and (*b*) introducing a small quantity of fuel at about 40 to 50 deg before top dead center (pilot injection), in order to start combustion, and following it with the main charge after the flame has established itself.

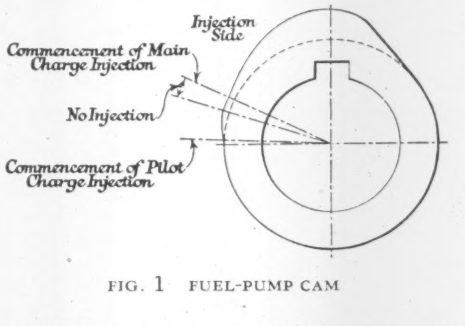
Injection Side
Commencement of Main Charge Injection
No Injection
Commencement of Pilot Charge Injection

FIG. 1 FUEL-PUMP CAM

The author reports researches carried out at Birmingham (England) University in which the effect of pilot injection was studied in a four-stroke-cycle, direct-injection Tangye oil engine having a single cylinder $4^3/_8$ in. in diameter by $5^3/_4$ in. stroke running at a normal speed of 1200 rpm. Two fuel pumps and two nozzles of the Bosch type were used, one a main injection pump and nozzle and the second the pilot pump and nozzle. Various different quantities of injected fuel from the pilot pump were tried and the timing of the injection of the pilot jet was varied over a wide range for three different values of the timing of injection of the main pump.

The tests revealed that there is, in some cases, a marked improvement in the engine's running, in so far as knock and torque questions are concerned. In all cases, with certain angles of pilot injection advance, the delay period of the main pump was nearly decreased to zero.

As a practical means of reducing Diesel knock the cam shown in Fig. 1 is suggested by the author. This cam may be allowed to operate the fuel-pump plunger and thus a small quantity of the fuel may be injected at first (about 20 per cent of the main quantity in the case of the engine in question). This should be followed by the main charge about 40 deg later. The injection commences at about 40 to 50 deg before top dead center. For smooth running of the engine this cam saves the installation of two fuel pumps.

Wear of Metals

AMERICAN SOCIETY FOR TESTING MATERIALS

RECENTLY published as "Symposium on Wear of Metals," a group of papers on this subject presented at a meeting on April 5, 1937, sponsored by the Philadelphia District committee of the American Society for Testing Materials directs attention to general and specific problems and comments on an involved subject. Although the symposium includes papers on variables encountered in wear tests on cast iron and the wear of metals from the viewpoint of the automotive, power equipment, textile industries, and the railroads, only the more general introductory paper by H. W. Gillet, metallurgist, Battelle Memorial Institute, entitled "Considerations Involved in the Wear Testing of Metals" is covered by the following résumé.

Mr. Gillet assures us that considering what little we know about wear resistance and wear testing, much has been written on the subject, and to this latter fact the bibliography of 137 references provided by the author bears testimony. Yet despite all the thought and work on the subject and all the published articles, he asserts, we are, broadly speaking, still a long way from being able to predict with the assurance required for reasonable engineering precision what the relative lives of two competing metals will be in service, and we especially lack the ability to put a new alloy, on which service experience is lacking, into its correct position in a list of wear-resistant alloys on the basis of some laboratory tests.

Wear of a metal is defined by the author as its undesired gradual change in dimensions in service under frictional pressure. Sudden failures, such as the chipping of a too-brittle cultivator tooth when it strikes a stone, are not classed as wear, but the action of corrosion, concommitant with abrasion, cannot be wholly divorced from wear. Wear, he continues, is primarily, although not necessarily wholly, a surface phenomenon; it occurs between two or more moving parts pressing against each other; it occurs gradually; and it occurs in service.

After giving numerous examples of various kinds of wear, the author considers the mechanisms of wear.

The wear of a metal by another usually occurs in one of two ways. In one, asperities on the surface of the one catch on those of the other or penetrate to form mating asperities, and then particles of one or both mates are torn off in a fashion analogous to machining In the other, the mating metals come into molecular contact (metallic contact), adhere under the existing pressure by a sort of welding (galling), and are then torn apart with particles of one adhering to the other. In the extreme this is called seizure and naturally occurs the more readily the higher the pressure and temperature.

Separation of the metals by a film of lubricant, so that metal asperity cannot touch metal asperity or so that metal cannot come into molecular contact with metal, avoids either type of wear. The surface finish of bearings and other mating parts is of importance in the case of asperities. The ability of the metal to hold an adsorbed thick film of lubricant may help it to operate in spite of asperities, while the ability to hold even the thinnest film seems to avoid seizure.

What happens to the metal debris resulting from wear, and to extraneous grit, is important. If this loose material deforms to tiny flakes or to rounded particles or crushes to infinitesimally fine particles it may be swept off with the lubricant. Or it may embed itself into one of the parts and act as a lapping medium, or it may even embed itself so deeply as to be out of contact with the mating part and removed from doing harm. How the particles tear off, whether by splitting along cleavage planes or individual crystals, or by tearing out of whole crystals along grain boundaries, has its influence on the type and rate of wear.

Metal surfaces that wear well usually acquire a glaze, which might represent a cold-worked surface, an adherent oxide coating, or a conglomerate of worked metal, oxide, debris, carbonized lubricant, graphite, etc. If such a glaze continues to thicken it may finally spall off and a period of high wear ensues until a protective glaze is formed again.

When corrosion forms a nonprotective coating it accelerates wear, and obviously, the corrosive lubricants play a part in the attack upon some of the bearing metals. Moreover, the work hardening of the surface is of undoubted importance. The flow of metal tends to remove asperities and to produce a more nearly mechanically perfect surface. The hardening tends to resist the entrance of asperities on the mating surface or of extraneous grit. On the other hand, work hardening is normally accompanied by loss in toughness, so that brittle spalling of the worked surface may ensue.

When discussing so-called metal-to-metal wear, the author points out, we can seldom be certain that abrasive dust is absent, so that this main class of wear cannot be wholly separated from the other main class.

In wear by nonmetallics we probably have nothing akin to seizure, and the nonmetallics usually have very sharp corners so that very high local pressure occurs when such corners move against the metal. Any lubricant is likely to be cut through.

In either type of wear, as a result of extreme local pressure, local temperature increases, measurable only with difficulty if at all, may ensue. Some authorities think these local temperatures may rise to the melting or softening points of the material.

Wear testing, then, has to determine the resultant of many factors, some of which can be measured, some only named. Among these are, relating to the metal itself, hardness (resistance to penetration), resistance to deformation, toughness, ability to work harden and properties after work hardening, both at ordinary and elevated temperatures, ability to maintain an adsorbed film of lubricant, ability to take a glaze, ability to discard or embed debris and adventitious dirt, corrodibility, mode of tearing apart on a microscale, ability to be surfaced smoothly before installation, weldability under seizure conditions. From the point of view of clearance and distribution of stress, in bearings, piston rings, etc., thermal conductivity, thermal coefficient of expansion, and modulus of elasticity may enter.

Mechanically the fit and finish of the mating parts affect the problem. The conditions are affected by the nature and temperature of the environment, that is, the atmosphere and the lubricant present, as well as of the mating metal or abrasive.

The author concludes, therefore, that wear resistance is not an inherent property to be measured in absolute units as it does not exist apart from the conditions of service, and the purpose of a wear test is to evaluate wear resistance in use. It is axiomatic, he says, that since uses vary widely we can have no universal wear test but instead must have many types of wear tests, each corresponding truly with specific conditions of use. Wear problems are specific.

After stating briefly the requirements of a useful wear-test method and discussing simulated service tests, with reference to the work of several investigators, the author states that, broadly speaking, all laboratory wear-test methods can be divided into (*a*) those that choose a "standard" wearing material, either metal or abrasive, and assume that there is no wear upon it or that the wear may be disregarded, and (*b*) those that wear upon both of the two coacting members. He closes with the following paragraphs:

An understanding of the mechanism of wear in a particular service, gained by pure reasoning and metallurgical and mechanical common sense, or gained by trial and error in trying to develop a test, is perhaps the best guide to a satisfactory test, and more attention to the fundamental mechanisms of wear and to designing apparatus that reproduces the particular ones that hold in the service in question will be more fruitful than will the blind adoption of some "standard" wear test that does not truly represent the case.

Wear-resistance is not an inherent property. It cannot be determined or even discussed apart from the specific conditions of use, any more than can machinability or corrosion resistance. Wear is the resultant of the material itself, the mating material, and the operating conditions. Omission of any one of the important elements in a parallelogram of forces gives a resultant of wrong length and pointing in the wrong direction. To be worth their cost, wear tests must point in the right direction.

So let us stop bewailing the lack of a "standard" wear test. There is no such animal, and there ought not to be. Instead let us each build wear-test outfits as we need them, intelligently designed to simulate the particular service we want to improve.

Continuous Welded Rail

RAILWAY AGE

HOW the Delaware and Hudson welds rails in lengths of 780 ft on flat cars and joins these sections by welding into continuous-rail tracks in excess of a mile in length is told in the Sept. 4, 1937, issue of *Railway Age*. In this work the railroad is now using the electric flash butt weld, although it continues to employ the Thermit pressure weld and is employing the latter process for joining in track all long sections of rail produced by the flash-welding process. A larger part of the electric flash welding now being carried on is being done under contract by portable equipment developed by the Sperry Rail Service. It includes a heat-treatment of the rail ends to relieve stresses set up as a result of the welding, and the necessary grinding to produce the best joint conditions.

The equipment employed in flash welding on the D. & H. involves essentially a welding car, housing a specially constructed flash-welding machine; a generator car, housing two turbogenerators for supplying current for the flash-welding operations; a steam locomotive for supplying steam to the turbogenerators; a rail-rack car for lining up and otherwise preparing the rails for movement to the welding machine; a series of five flat cars on which the stress-relieving equipment and joint grinders are located; and the requisite number of flat or open-end gondola cars for holding the long rails for subsequent movement out on the line.

The making of the flash welds involves three steps—preheating of the rail ends to be joined, flashing, and a push-up. Arranged for welding, the rails are gripped simultaneously by the clamping devices and current contact pads in the two parts of the welding machine. In the preheating operation, the single rail, fixed to the movable platten, is brought up to intermittent short-circuiting contact with the end of the fixed rail, which in a short time raises the temperature of the rail metal at the ends to practically a fusing heat. When this stage has been reached, the flashing operation is carried out, which involves continuous short circuiting of the welding current by bringing the rail ends into continuous contact.

After a predetermined amount of flashing, the rail ends are squeezed together under hydraulic pressure, causing the molten metal at the ends to fuse together, and producing an upset area around the periphery of the rail at the point of weld. Immediately following the push-up operation, the rail clamp on the movable platten of the machine is released from the rail, and, under hydraulic pressure, the platten is moved forward to a point where it shears off the upset metal on the underside of the rail base.

While each weld is being made, certain completion operations are carried out on the welds previously completed on the flat cars immediately adjacent to the welding car. These operations, which proceed five joints at a time, complete the conditioning of the welds for service in the track. The first of the operations is a process of stress relieving through the weld area, while all of the following operations involve the grinding away of the undesirable portions of upset metal.

The stress-relieving operation is carried out in an oil-fired heating oven, or furnace, wherein the rail immediately at the weld and for a distance of 18 to 20 in. each way from the weld is brought to a predetermined temperature, and then allowed to cool under atmospheric conditions.

In the grinding operations following the stress-relieving operation, the upset metal about the weld is first ground off the sides of the rail head. This is followed by the removal of the upset material from the underside of the rail head on both sides, through the fillet area, and from the top of the base flanges, and then by the rough-grinding of the rail head. The final grinding operation involves smoothing-up the rail head through the weld area with a reciprocating-type grinder.

As the strings of rails are extended by each new weld, they are pulled forward the proper distance through the welding machine, onto the storage cars, by means of a cable and an electrically operated haulage winch located on a flat car at the far end of the storage cars.

After the welded lengths of rail have been unloaded at the site of laying, they are equipped on the ground with new tie plates and either M. & L. or compression-type spring clips, and are subsequently lined over into position in the track and temporarily joined together with standard four-hole rail-joint bars, employing bolts in only the end holes. Later, all of these mechanical joints are removed in turn and the long lengths of welded rail are joined together by Thermit pressure welds, bringing about continuous rails up to a mile or more in length between insulated joints.

The unloading of the long rails is accomplished by pulling them off from the rear of the train and laying them down immediately outside of the running rails on the track shoulder. The lengths are then barred onto the tie ends, as necessary, workwise, ready for the application of the new tie plates and for lining into position in the track. During the rail-renewal operations, the two outside bolt holes are drilled in the rails and the bars are applied, forming the temporary connection until the Thermit closure weld can be made.

Electromagnetic Fret Saw

ENGINEERING

A SIMPLE power fret saw operated by an electromagnet has been brought out by A.E.G., of Berlin, according to a report in the Oct. 8, 1937, issue of *Engineering*. The principle is illustrated in Fig. 2 in which *a* is an electromagnet situated below a steel diaphragm *b* supported at opposite edges in rubber holders *cc*. On the upper side of the diaphragm, in the center, there is a clamp in which the lower end of the fret saw *d* is fixed. The upper end of the saw blade is fixed to a flexible bow *e*. The coil of the electromagnet is connected to an ordinary alternating-current lighting circuit, and the alternating field produced results in the upward and downward deflection of the diaphragm at each half period, recovery being attained as the current passes through its zero value. With a periodicity of 50 the diaphragm makes 6000 vibrations per minute. The length of the stroke may be varied by altering the vertical position of the electromagnet by means of a controlling screw. Action of the saw may be started and stopped by means of a pedal switch or a hand switch.

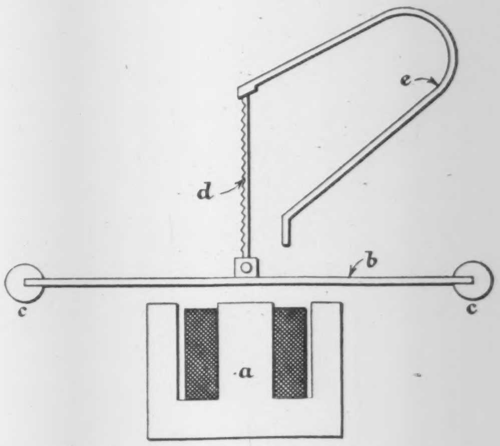

FIG. 2

Emmet Mercury-Vapor Process

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

IN AN address delivered at the 1937 National Fall Meeting of The American Society of Mechanical Engineers, published in Mechanical Engineering for November, 1937, W. L. R. Emmet, A.S.M.E. medalist, referred to a paper "Ship Propulsion by the Emmet Mercury-Vapor Process," which was presented at the 1937 annual meeting of The Society of Naval Architects and Marine Engineers.

Mr. Emmet describes a mercury boiler, Fig. 3, now in operation at Pittsfield, Mass., and illustrates its use by the case of the *Normandie*, where, he says, it might be desirable to install 72 such units, and by the case of a 3000-hp geared turbine tanker, which could be run by one. In regard to the boiler, Mr. Emmet says that most of the tube surface is exposed on the walls of an elongated cylindrical chamber to which flame is delivered from a single burner at the end where the circulating mercury liquid enters. Under such conditions, the heat is delivered mainly by radiation, the high temperature range used in mercury making this practical and desirable.

The elongated shape of this chamber has two objects—saving of floor space and proximity of the burning gases to the tubes on the walls. Burning gases are more or less opaque to radiation, and this proximity, which was originally based on theory, has in practice been proved to be of great value. In the case of tubes such as are used in this boiler, the conditions of action have been carefully experimented with in individual tubes While it is not desirable to go much into detail, in action a large part of the liquid which the tube may have contained is expelled by the escaping vapor, and the work required to impart motion to this escaping liquid creates back pressure at the point where liquid enters the tubes. The more liquid that enters the tube, the more the back pressure; consequently, there is an automatic tendency to distribution of the liquid among the different tubes. The passage of the liquid from the tube may be likened to the discharge of shot from a gun.

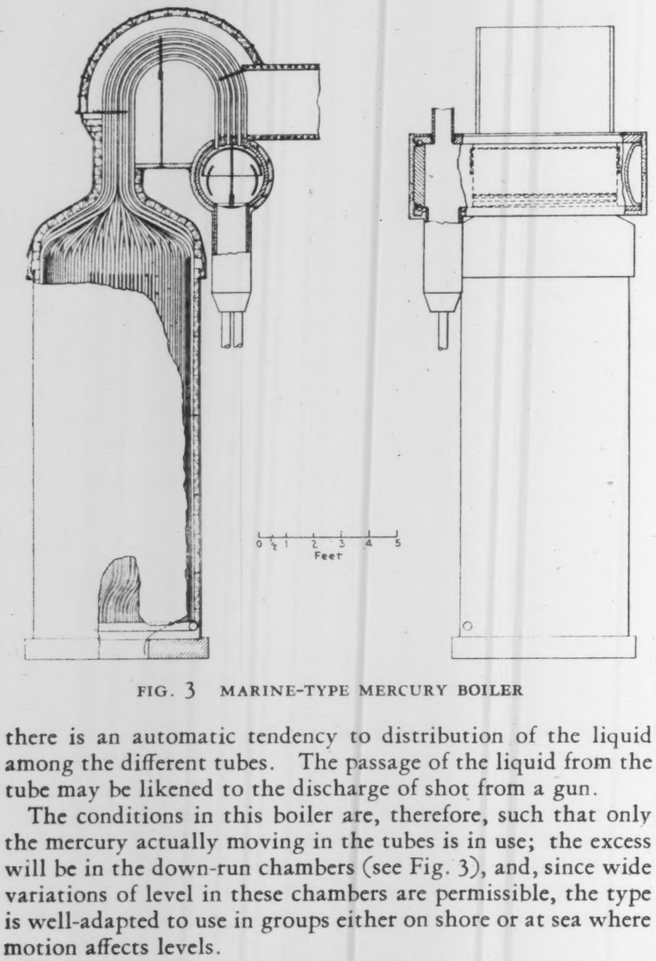

FIG. 3 MARINE-TYPE MERCURY BOILER

The conditions in this boiler are, therefore, such that only the mercury actually moving in the tubes is in use; the excess will be in the down-run chambers (see Fig. 3), and, since wide variations of level in these chambers are permissible, the type is well-adapted to use in groups either on shore or at sea where motion affects levels.

In the case of the *Normandie* Mr. Emmet predicts that the weight saving, if the mercury-vapor process were adopted for it, would be something over 1700 tons in propelling machinery and 3300 tons in fuel when leaving New York, plus an unknown weight of auxiliaries and stack facilities. As for fuel, he estimates a saving of about 38 per cent. The space saving would be about 400,000 cu ft. As to cost, Mr. Emmet says that the cost of mercury required would be much more than offset by a less cost of machinery.

One condition which makes the mercury process peculiarly practical for ships is the extreme simplicity of the making of steam by the condensation of the mercury vapor. The surface required is small and can be made readily accessible for cleaning. The temperature differences involved will generally not exceed 20 F, so that no trouble or maintenance expense are to be expected, even if the worst water is used.

At the normal load planned for such boiler units, the six groups of twelve boilers shown for the *Normandie* would, with her present auxiliary steam uses, give the ship about 190,000 shaft horsepower. She could easily run with four of the six groups at her normal 130,000 shaft horsepower.

Aeronautic Statistics

U. S. DEPARTMENT OF COMMERCE

FOR lovers of statistics the following figures have been assembled from "Civil Aeronautics in the United States," Aeronautic Bulletin No. 1, Bureau of Air Commerce, U. S. Department of Commerce, Aug. 1, 1937.

Air mail carried in 1936 amounted to 18,324,012 lb. On July 1, 1937, there were 55,208 miles of mail airways. The daily average of flying miles scheduled for United States contract air mail was 180,367, carried on 70 domestic routes and 15 routes to Canada, the West Indies, Mexico, Central America, South America, and across the Pacific to Hawaii, the Philippines, and China.

In 1936 1,147,696 passengers were carried by air lines in the United States, and on Jan. 1, 1937, the average passenger rate for domestic air lines was 5.6 cents per mile. In 1936 the amount of air express carried was 8,350,010 lb.

As of April 1, 1937, there were in the United States 9326 aircraft, 363 gliders, 15,865 pilots, and 133 glider pilots; and on Jan. 1, 1937, there were 2342 airports and landing fields.

The total production of airplanes in 1936 was 3010.

Aircraft, engines, equipment, and spare parts produced in 1936 were valued at $78,148,893. The value of airplanes and parts was $47,531,565.

Three captive and two free balloons were produced during the year. The value of the lighter-than-air craft, plus spare parts, totaled $38,709.

Number and value of engines were compiled separately. In all, 4295 aircraft engines were built, which, together with spare parts, were valued at $26,383,055. Total value of propellers, parachutes, and pontoons was $4,234,273.

Employees of aeronautical manufacturers totaled 30,575 in 1936. These included 18,448 factory and 5083 office employees of airplane manufacturers, a total of 23,531, and 5531 factory and 1513 office employees of engine, propeller, and accessory manufacturers, a total of 7044.

Of the total airplanes produced in 1936, 1637 craft were for domestic civil use, 858 were for delivery to military establishments, and 515 were exported.

The industry produced 1433 monoplanes and 204 biplanes. The 1433 monoplanes included 110 of the open-cockpit type and 1323 cabin craft. Of the biplanes, 29 were open-cockpit and 175 were cabin craft.

Additional information obtained by the Bureau with respect to the 1637 aircraft manufactured for domestic civil use in 1936 showed that 14 companies manufactured 20 or more each of these craft, accounting for approximately 90 per cent of the aircraft manufactured for domestic civil use. Fifteen companies produced 2 to 14 airplanes each, and 102 companies or individuals produced 1 airplane each.

Taking all aeronautic products as a whole, the leading markets in 1936 were China, Argentina, The Netherlands, Netherland Indies, and Japan, in the order named, and American airplanes, engines, parachutes, parts, and accessories went also to purchasers in 76 other countries. The totals were: 515 planes worth $11,386,896, 945 engines worth $5,397,469, parachutes and parachute parts valued at $298,358, and airplane parts and accessories worth $6,060,483. The total value was $23,143,206, the largest in the history of the industry.

Feathering Propeller

CURTISS-WRIGHT CORPORATION

CURIOSITY concerning the electrically controlled, constant-speed, feathering, airplane propeller mentioned in a brief note in our issue of October is justification for a more adequate description of the device. The material which follows has been assembled from information provided by the Curtiss-Wright Corporation in a bulletin entitled "Constant-Speed Feathering Propeller."

The large pitch range inherent in the design of this propeller makes it possible to "feather" the blades (increase the pitch until the blade angle is approximately 85 deg). This feature makes it possible to stop the rotation of the propeller on a dead engine and, by so doing, introduces a number of advantages which are indispensable to the operators of multi-engine airplanes.

Pitch changes are made in the propeller through the medium of an electric motor mounted on the front of the hub. A two-stage planetary-gear speed reducer transmits the energy, produced by the electric motor, to the blades by means of a single master bevel gear which engages a mating bevel gear attached to the butt of each blade. Reversal of change is accomplished by means of a double field winding in the electric motor.

Power is supplied to the electric motor by means of a set of four collector rings mounted on the rear of the hub which are contacted by carbon brushes on the engine crankcase.

The power for changing pitch is furnished by a 12-volt, direct-current, series-wound electric motor. The motor draws an average current of 18 amp while performing a pitch change. The torque of the electric motor is transmitted through a two-stage planetary-gear speed reducer which has a total reduction ratio of 14,706:1, to a steel bevel gear. This bevel gear, known as the master gear, engages the blade gears.

In order to prevent overtravel during pitch-change operations and in order to prevent "creeping" of the gear train due to vibration, a spring-loaded brake is mounted on the motor shaft at the front face of the motor. This brake is always engaged when the fields of the motor are not energized for changing pitch. An electromagnetic winding connected in series with the armature automatically releases the brake during pitch-change operation.

The slow-speed end of the speed-reduction unit is equipped with a set of two electric cutout switches which may be set to limit the pitch change in either direction within accurate limits. These cutout switches are supplemented by an adjustable mechanical low-limit stop which is set to stop decrease of pitch approximately one degree below the point at which the low-limit electrical cutout switch functions. This stop is merely an extra precaution to assure that the propeller blades never decrease pitch into an unsafe operating range.

Control is provided by a spring-loaded flyweight governor driven by the airplane engine which operates an electrical switching device thereby energizing the propeller-control motor in the correct direction and proper magnitude to hold the governor flyweights and spring stable. The governor spring is adjustable by the pilot during flight so that the engine speed at which the governor will stabilize may be easily controlled. The electrical circuit of the governor energizes the electric motor through a double-throw relay.

Rotary Pump

MACHINERY (LONDON)

AMONG the advantages claimed for the Keelavite rotary pump recently placed on the market by a British manufacturer and described in *Machinery* (London) for Oct. 7, 1937, is a constant rate of delivery free from pulsation. Fig. 4 is a diagram of the pump.

Within a stationary outer casing *A* rotates the rotor *B* which is mounted on the drive shaft. Circular recesses in the rotor accommodate blades *C*, which are mounted on roller bearings and are free to rotate about their own axes relative to the rotors. A gear on the driving shaft is connected through idlers with a gear on each of the blade shafts so that, as the rotor revolves about its axis in one direction, the blades are rotated about their own axes at the same speed but in the opposite direction, the net effect being that the angular disposition of the blade in relation to the fixed casing is always the same.

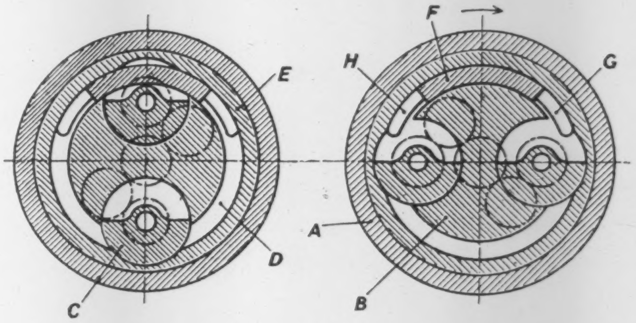

FIG. 4 DIAGRAM ILLUSTRATING PRINCIPLE OF OPERATION OF KEELAVITE ROTARY PUMP

At least one of the blades always maintains a seal with the walls of the working chamber *D*. The outer wall of this chamber is in the form of a ring integral with the rotor and consequently running at the same speed. Recesses are formed in this ring which, in effect, merely complete the recesses in the rotor proper and allow the blades to rotate relative thereto. The relative movement between the blades and the ring is thus confined to that due to the rotation of the blades about their own axes and there is a considerable area of engagement for effective sealing. As the seal depends on the fit of each blade in its recess and since both recess and blade are of circular form, the limits of accuracy necessary to insure that the clearance is maintained at the desired figure can be readily adhered to.

In conjunction with the rotor the fixed abutment *F* provides a permanent seal between inlet port *G* and exhaust port *H*. The output of the pump during one revolution is equal to the volume of the working chamber, or the volume of the annular space between the rotor and the casing.

It is said that a pump of this type was run at a speed of 1000 rpm, corresponding to a delivery of 7.7 gpm. When delivering antifreezing oil (viscosity Redwood No. 1, 127 sec) against a pressure of 500 lb per sq in., the volumetric efficiency was 97 per cent; for the same oil and for a delivery pressure of 1000 lb per sq in. (viscosity Redwood No. 1, 100 sec), the corresponding figure was 92 per cent.

LETTERS AND COMMENT

Brief Articles of Current Interest, Discussion of Papers in Previous Issues

The Scientific Research Bill

To the Editor:

The Scientific Research Bill which was the subject of an editorial appearing in the October issue is an addition to the many attempts being made by our federal government to place politicians in control of the details of each domestic day of each and all citizens. If it is enacted and its provisions executed, we shall have politicians posing as scientists controlling and directing the activities of each of the great research laboratories which are parts of our large industries and educational institutions. We may also have them controlling and directing the activities of The American Society of Mechanical Engineers and other engineering organizations.

The enactment of that bill could have only one result and this would be the introduction into scientific research of the inefficiency, failure, and waste we now have in attempts of the Department of Agriculture to solve agricultural problems, the Department of Labor to solve labor problems, the Shipping Board to solve problems of merchant marine, and, furthermore, the federal government to solve governmental problems.

This bill, like many others, is presented under the general-welfare clause of the Constitution, and that clause is being used as justification for political usurpation of power to annul all its provisions. Politicians are ignoring restrictions placed on the use of governmental power by the Constitution which they are under oath to sustain, using that power in any way they see fit, and claiming that they are promoting general welfare. They are seeking changes in the Constitution which will secure them in continued control of powers which they have usurped and to which they have no just claim.

All power rests in the people. Through the Constitution, the people of this country conveyed to our federal government control of a small, definite, and carefully specified portion of their power. Control of the large remaining portion they reserved for their own use. When the federal government performs any act that is not an application of control of the definite powers conveyed to it by the Constitution, it must, therefore, usurp the required control of power from the people, its only source. The federal government, having no just claim to control of that additional power, is neither designed nor constructed to carry on its proper administration. Hence, the notorious inefficiency, failure, and waste in the administration of the affairs of that government.

Clement F. Street.[1]

Fluid-Flow Analyzer

To the Editor:

Mr. Parr has described[2] a beautifully simple instrument for studying hydrodynamic problems, but is not the apparatus intended essentially for those cases of flow that we describe as laminar? True, the majority of hydrodynamic problems found in nature are laminar, but, nevertheless, a vast number are primarily turbulent, and it is largely these whose solution is of greatest concern to the present-day engineer. A study of the hydrodynamic problem from the laminar view point will not necessarily serve as a clue to its solution when subject to turbulent conditions; in fact, the results, as we know from the classic Prandtl sphere experiments, may be several hundred per cent in error. Is it not imperative, then, that we ascertain whether the problem to be studied falls into the group that can be treated as laminar before we attempt a qualitative solution along the lines suggested by Mr. Parr?

In interpreting flow problems that are studied by smoke processes, floating aluminum particles, or similar methods, when a moving camera or some other relative point of view is not employed, are not the results somewhat ambiguous? For instance, in Mr. Parr's apparatus a definitely peaked velocity profile must exist in the $^1/_4$-in. channel. Are we certain that this does not alter the two-dimensional aspect of any problem we attempt to study by this means?

Ronald B. Smith.[3]

Direct Computation of Pipe-Line Discharge

To the Editor:

Relative to the discussion appearing in the August issue[4] of Mechanical Engineering as initiated by a letter from Ed S. Smith, Jr., in the May issue,[5] it seems pertinent to indicate that absolutely no occasion exists for the trial-and-error methods that have customarily been employed in such pipe-flow problems and which are implied in those letters.

This statement is premised on the availability of data relating the so-called friction factor f with the Reynolds number R for the type of pipe in question. That such trial-and-error procedure is then unnecessary and that *direct* solution for obtainable volumetric capacity, required pipe size, and similar items may be made with utmost directness was clearly indicated by S. P. Johnson in "A Survey of Flow Calculation Methods" as presented at the A.S.M.E. 1934 Semi-Annual Meeting. Also, as Johnson notes, Reynolds himself indicated the same consideration as early as 1885.

The practical utility of the methods suggested by Johnson is great. However, his presentation was somewhat difficult to follow, and the conditions of its publication probably gave it an unfortunately limited distribution. Consequently, it seems well here to summarize his thesis as briefly as possible and also to supply a technique of utilization that he did not delineate in the paper as clearly as might perhaps be desired. In effect he showed the obvious consideration that, if the friction factor f is a function of the Reynolds number R, then for a pipe of the same relative roughness λ, correspondingly definite functional relations must likewise exist between these dimensionless parameters and any desired and convenient combination of them.

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[1] Consulting Engineer, Greenwich, Conn. Mem. A.S.M.E.

[2] "Fluid-Flow Analyzer," by H. L. Parr, Mechanical Engineering, June, 1937, pp. 437–439.

[3] Turbine department, Elliott Company, Jeannette, Pa.

[4] "Computation of Pipe-Line Discharge," Mechanical Engineering, August, 1937, pp. 628–629.

[5] "Direct Computation of Pipe-Line Discharge," Mechanical Engineering, May, 1937, p. 375.

The symbols of the diagram, Fig. 1, which was Fig. 3 of the original paper and the units to which the values of the parameters of the diagram correspond are, for convenience, given as follows:

D = internal diameter of pipe, or mean hydraulic radius × 4, ft
p' = pressure drop per foot length of horizontal pipe due to friction, poundals per sq ft per lin ft (lb per sq in. × 4633)
Q = rate of flow through pipe, cfs
v = mean velocity in pipe, fps
μ = absolute viscosity of liquid, poundals-sec per sq ft or lb per sec-ft (poises × 10.0672)
ρ = density of liquid, lb per cu ft

The original parameters and those combinations that are found to be most useful and which become the coordinates of Johnson's diagram are

(*a*) $f = 2Dp'/\rho v^2$ which is a common form in which the friction factor appears.

(*b*) $f = \pi^2 D^5 p'/8\rho Q^2$ in which the usually more practically convenient item of volumetric rate of flow $Q = \pi D^2 v/4$, is introduced.

(*c*) $R = Dv\rho/\mu$ which is the familiar Reynolds number.

(*d*) $R = 4Q\rho/\pi\mu D$ in which again Q appears in lieu of v. Note also that $Q\rho$ is the rate of flow in lb per sec.

(*e*) $R \times (f/2)^{1/2} = (p'D^3\rho)^{1/2}/\mu$ which is shown in the following to be a most convenient parameter for *direct* determination of flow rate, given other pertinent data.

(*f*) $R(f/2)^{1/5}(\pi/4)^{2/5} = (Q^3p'\rho^4)^{1/5}/\mu$, a most convenient parameter for direct determination of pipe size, given other data.

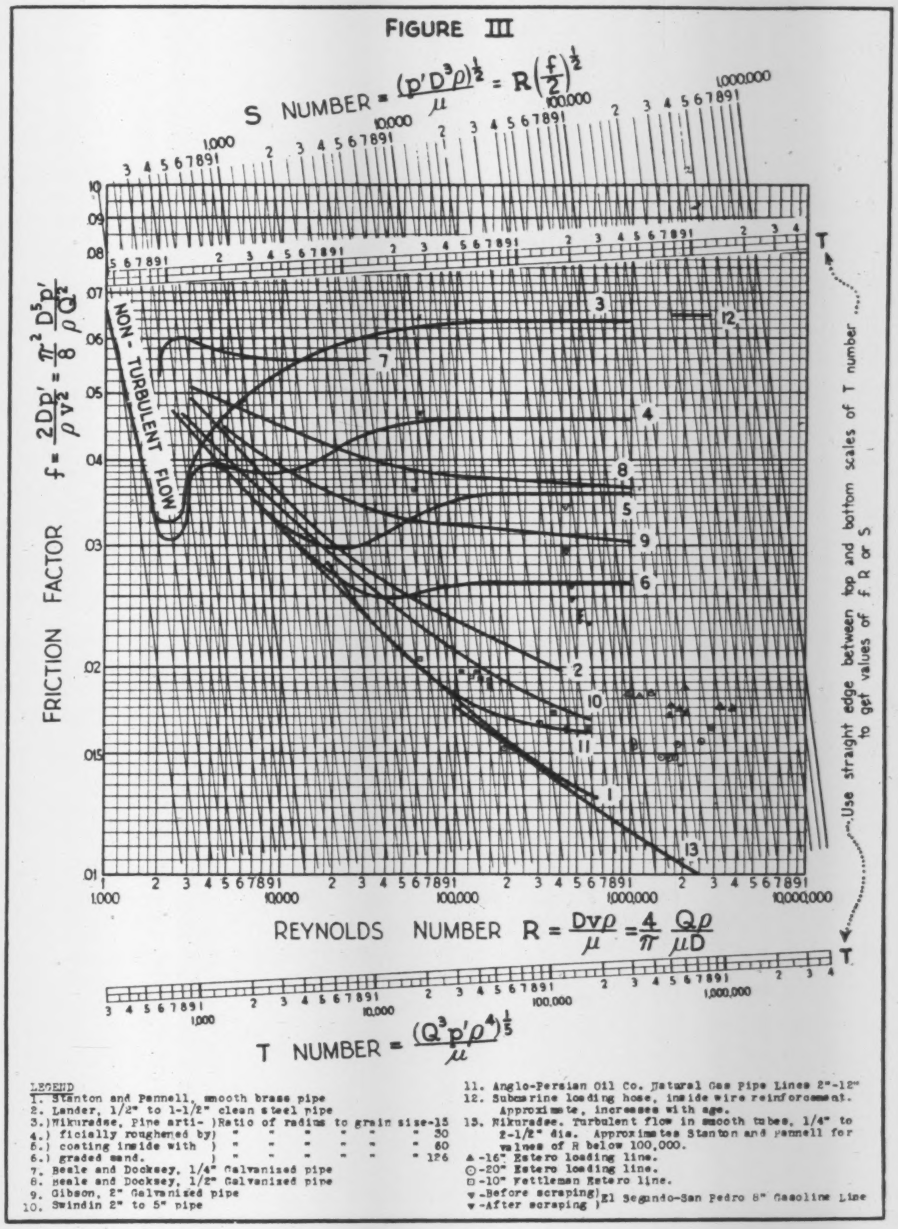

FIG. 1 RELATIONS BETWEEN FRICTION FACTOR AND REYNOLDS' NUMBER

Fig. 1 will be seen to present parameters (*a*) and (*b*) as the ordinate versus parameters (*c*) and (*d*) as the abscissa. Parameters (*a*) and (*c*) are, of course, the conventional coordinates of more recent types of pipe-flow diagrams. There also appear, however, the corresponding values of the parameters (*e*) and (*f*), on necessarily skewed coordinates and designated respectively as the S and T numbers. It is evident that, with respect to any specific value of, say, R, as determined by either of the foregoing expressions for that parameter, and a particular character of pipe, λ, the correspondingly required magnitudes of the other parameters are read by following the proper coordinate line, horizontal or skewed, to its corresponding scale.

TABLE 1 SCHEDULE OF PROCEDURE

(Relative surface roughness of pipe is here denoted as λ)

			Procedure	
Case	Desired item	Available data	Enter chart at computed value of parameter	Follow coordinate to curve for pipe in question, and so determine value of following parameter
1	p'	D, μ, ρ, λ, and v or Q	(*c*) or (*d*)	(*a*) or (*b*)
2	D	p', μ, ρ, λ, and Q	(*f*)	(*b*)
3	v or Q	D, u, ρ, λ, and p'	(*e*)	(*a*) or (*b*)
4	Allowable value of μ	D, p', ρ, λ, and v or Q	(*a*) or (*b*)	(*c*) or (*d*)
5	Suitable character of pipe λ	D, p', μ, ρ, and v or Q	(*a*) and (*c*) or (*b*) and (*d*)	Ascertain allowable roughness from intersection of parameters

To provide more concrete information concerning the direct method of procedure with the complete chart for the solution of any character of practical problem, including those that have conventionally been regarded as necessitating trial-and-error methods, Table 1 will serve.

Case 1 is the conventional elementary

problem commonly presented in the literature, except that ready means are also available for working directly in terms of rate of discharge rather than mean velocity. Cases 2 and 3 are ones that have commonly been regarded as necessitating the bothersome trial-and-error method. Case 4 relates to computations of the required temperature and consequent viscosity to which it may be necessary to bring an oil for economical long-distance pumping and has also been regarded as requiring trial-and-error procedure. Case 5, perhaps, offers a new viewpoint and method of attack for a certain type of problem.

PAUL J. KIEFER.[6]

An Author Protests

A REVIEW of "Thermodynamics for Engineers," by H. F. Gauss, appeared in the June issue of MECHANICAL ENGINEERING. The author feels that several statements therein might be misleading and submits the following.

The illustrations are referred to as heterogeneous and in substantiation one is cited used in connection with the discussion of refrigeration, and appearing on page 260, and another dealing with an investigation of fan characteristics appearing in an appendix, and not a part of the text proper. As a matter of fact, the author spared no effort to illustrate carefully theory with practice and the illustrations are numerous but each accompanies the theoretical discussion to which it belongs and could not be referred to as heterogeneous.

The temperature-entropy diagram is developed and its application illustrated before the enthalpy-entropy diagram. The latter is useful only for graphical computations avoiding tedious arithmetic, but the former has a thermodynamic background requiring a highly technical presentation. As a matter of fact, both diagrams are freely used throughout the text.

Much space in the text is devoted to a discussion of the new Keenan steam tables and their use is recommended as stated on page 128. Some use is made of Marks and Davis' steam tables, the reason for which is explained on page 128. Keyes and Brownlee's tables are used for the solution of problems in refrigeration but Goodnough's are not; also the existence of more recent tables is recognized on page 248.

The author had no idea of presenting anything new in theory or practice. However, many of the methods of presentation have features not appearing in other texts.

H. F. GAUSS.[7]

Definition of the Inch

TO THE EDITOR:

At the 27th International Conference on Weights and Measures in Washington, June 1, 1937, Dr. Lyman J. Briggs, Director of the National Bureau of Standards, presented a paper on "A Proposal for Legislation to Fix the Standards of Weights and Measures in the United States." In the introductory paragraphs of his paper Dr. Briggs observed that it is strange that 150 years after the founding of this Republic legislation should be necessary to fix the value of the inch and the pound. Nevertheless it is a fact that we have never had a statute defining the way in which those units shall be determined.

In our transition from British colonies to independent states, subsequently federated, we inherited the English system of weights and measures, but prior to Act of Parliament in 1824, which defined the yard in terms of a pendulum beating seconds at Greenwich there was no definition except with respect to a certain bronze bar, and the gravity definition was therefore posterior to our independence, not anterior. In this country there has been no analogous legislation and no reference bar.

In the legislation proposed by Dr. Briggs the conversion factor, one inch equals 25.4 millimeters, is adopted. Dr. Briggs' bill derives arbitrarily the American inch from the international prototype of the meter, or alternatively from the wave length of the red radiation from cadmium light, and in so doing, we do not for a moment relinquish the units of our customary system of weights and measures.

The legislation proposed by Dr. Briggs was subsequently introduced in Congress as HR7869 and S2785. Following a hearing by the Committee on Coinage, Weights, and Measures, the bill was approved and was referred to the House calendar, on which it received No. 190, this being only a few days prior to the adjournment of the first session of the 75th Congress. There has not yet been any action with respect to the bill introduced in the Senate.

The subject is manifestly one of real importance. The variations in inch-standard, computed in one way or another, appear only in digits far to the right of the decimal point, but in these days of refined measurements, when machinists work to accuracy expressed in ten-thousandths of an inch, and when scientists talk about millionths of an inch, and even of ten-millionths, the exactness of the standard is a matter of concern. The Johansson division of the Ford Motor Co. recently demonstrated publicly the use of the Johansson gage block, of which the most refined type is accurate within two millionths of an inch.

The subject is being approached both by the National Bureau of Standards and by our industrial organizations in a spirit that is free from controversy in regard to the English system vs. the metric system of weights and measures. There is common agreement in this country, and important agreement in Great Britain, upon correlation of one inch equals 25.4 millimeters and vice versa. There is also agreement that the best basis for standardizing is the red ray of cadmium light. It is recognized, however, that the adoption of the bill embodying the proposal of Dr. Briggs will create a slight difference between the American inch and the British inch, unless the British do the same thing that it is now proposed that we shall do. There are, therefore, strong feelings of regret that Dr. Briggs has tied the definitions alternatively with cadmium rays and the prototype meter bar in the National Bureau of Standards, instead of with cadmium rays alone; and that we should be taking this step without any conference with, or even any overture to, the British, who would be receptive, we have reason to believe. Our national organizations, like the American Institute of Weights and Measures, the National Machine Tool Builders Association, and the Metal Cutting Tool Institute, besides our leading manufacturers of gages, tools, etc., would be pleased if the bill that is now before the House should be amended in line with these thoughts, to which Dr. Briggs would probably offer no opposition; and would be even more pleased if legislation were deferred until Anglo-American conformity should be either accomplished or ascertained to be impossible. We should not anticipate the latter conclusion. Inasmuch as we have managed without a precise legal definition of the inch for 150 years a further delay of two or three years would hardly be embarrassing to anybody.

W. R. INGALLS.[8]

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[6] Professor of Mechanical Engineering, U. S. N. Postgraduate School, Annapolis, Md. Mem. A.S.M.E.

[7] Head, Department of Mechanical Engineering, University of Idaho, Moscow, Idaho. Mem. A.S.M.E.

[8] Consulting Engineer; president, American Institute of Weights and Measures, New York.

The Electric Gage

To the Editor

I wish to congratulate the authors upon their excellent paper.[9] They mention casually that various forms of these devices have found use in continuous measurement of strip and sheet thickness during manufacture. This is a most important application of the electric gage, and it has had an important effect in developing the manufacturing processes of steel strip and tin plate which may not be generally appreciated.

Doubtless most engineers have read of the wide application of the continuous rolling mill to hot and cold steel-strip and tin-plate manufacture. Today, numbers of cold-strip rolling mills, consisting of four or five stands in tandem are producing cold-rolled steel strip to be used for tin plate. These mills deliver strip approximately 30 in. wide and approximately 10 mils thick at speeds up to 1300 or 1400 fpm. Without some form of continuous gaging of strip thickness, such as has been made possible by use of the electric-gage principle in the Pratt & Whitney Co.'s development of the continuous electrolimit gage, such rolling speeds would not be commercially feasible.

To produce a commercially salable product, the thickness of the finished strip must be held within close limits, and because of unavoidable variations in the thickness of the hot-rolled strip entering the mill and possibly other variables, a continuous check on the thickness of the strip leaving the mill must be obtained. Before the advent of the electrolimit gage, strip speeds on wide mills were largely limited to values that would permit micrometer gaging by hand, or on the order of 200 to 250 fpm. Running at higher speeds and slowing down for periodic gaging is not successful because, even with the same settings of mill rolls, the thickness of the finished strip may vary considerably as speed changes.

In view of the foregoing, the modern high-speed cold tin-plate mill could not be operated without the continuous electrolimit gage, or some other method of continuously gaging strip thickness. Therefore, the development of the electric gage has been a real factor in promoting the expansion of the cold, and through it hot, rolling of steel strip.

Another application of the electric gage in strip rolling is the so-called tensiometer, which is used for measuring the tension in the cold strip between two adjacent roll stands in a tandem mill. In this device, a steel roll mounted in suitable roller bearings, is placed so that its upper surface is slightly above the horizontal line that the strip normally assumes in passing from one roll stand to the next. Therefore, the strip is forced out of the horizontal line by this roller and the pressure downward on it is a measure of the tension in the strip. The bearings of the roller are spring-mounted, and an electric gage is used to measure the small deflection of the springs which is caused by the tension in the strip. Properly calibrated, therefore, the electric gage gives a direct indication of the tension in the strip. Working through a suitable regulator on the field of the motor driving one of the roll stands, this gage can automatically control the tension in the strip. Since the tension in the strip between stands has a direct effect upon the reduction produced with a given roll setting, the measurement of this tension, and its control, is an important consideration in producing strip of uniform thickness.

H. A. Winne.[10]

The Problem of Investment

To the Editor:

In his review of the book "The Problem of Investment," by F. T. Shaffner, Prof. Floyd E. Armstrong discusses the question of hedges against inflation. He rightly remarks that bonds and all dollar contracts should in substantial measure be replaced by real property or direct claims thereto in the form of well-chosen common stocks. May I point out that, to some extent, a further possibility exists of safeguarding the investor by the issuance of bonds, the capital and interest of which are expressed in commodities.

Take, for instance, an oil company. It could issue bonds reading in gallons or barrels of a well-defined oil; bearing interest at a given percentage. Both capital and interest are of course always paid in legal tender but the money amount changes in a predescribed ratio with the market quotation of this grade of oil.

Public utilities could base their issues on the price of the kilowatthour or 100 cu ft of gas, steel companies on the price of steel. Agricultural states would found their indebtedness on foodstuffs and so on.

The individual would protect himself as far as his living expenses are concerned (and in a violent inflation the individual is in a similar position as Talleyrand, the renowned French diplomat and statesman, who when asked what he did during the French Revolution replied, "I continued to live") in the following manner: In accordance with the items in his budget for fuel, electric power, and living expenses he will acquire the respective

THE KICK-OFF AS CAUGHT BY HIGH-SPEED CAMERA
(Address at A.S.M.E. Annual Meeting deals with high-speed pictures. See page 969.)

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[9] "The Electric Gage," by C. M. Hathaway and E. S. Lee, Mechanical Engineering, September, 1937, pp. 653–658.

[10] Engineering General Department, General Electric Company, Schenectady, N. Y.

bonds of oil companies and public utilities and state bonds, so that the interest on these bonds covers a part or the total of these items of his expenses including the operation of a car. As the money he receives corresponds to the prices he has to pay for these items, he will be able to purchase these without a loss. And as experience in past years in European countries has shown, when a violent inflation sets in, prices for the necessities of life nearly all move proportionally when considered over a wider range of time.

I should like to add that while common stock of course offers a better protection against inflation losses than bonds reading in legal tender they too will in some cases not fully answer this purpose and for the following reason. If companies have orders in hand which demand some time for delivery and if they have not made provisions with the customers and the purveyors of material insuring them against the rise in cost and rising wages they will soon meet with a shortage in cash. As the banks are unwilling to give credits, the companies must issue new stock. If the old stockholder has not sufficient means to acquire any of the new issue in proportion to his old holdings his investment in the company is reduced accordingly.

One may say that under these circumstances the commodity bonds of such an undertaking are also endangered but the answer to this is, that the interest on the bonds as a rule is small in comparison to the total capitalization, while by the time capital falls due matters will have adjusted themselves.

LIONEL FLEISCHMANN.[11]

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[11] Mount Tabor, N. J.

A.S.M.E. BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly for the purpose of considering communications relative to the Boiler Code. Anyone desiring information on the application of the Code is requested to communicate with the Secretary of the Committee, 29 West 39th St., New York, N. Y.

The procedure of the Committee in handling the cases is as follows: All inquiries must be in written form before they are accepted for consideration. Copies are sent by the Secretary of the Committee to all of the members of the Committee. The interpretation, in the form of a reply, is then prepared by the Committee and passed upon at a regular meeting of the Committee.

This interpretation is later submitted to the Council of The American Society of Mechanical Engineers for approval after which it is issued to the inquirer and also published in MECHANICAL ENGINEERING.

Following is a record of the interpretations of this Committee formulated at the meeting of September 17, 1937, which were subsequently approved by the Council.

CASE No. 808 (Reopened)

(*Interpretation of Par. H-24*)

Inquiry: *a* May the provisions of Par. P-216 be applied to heating boilers as an extension of the provisions of Par. H-24?

b In the case of welded low-pressure heating boilers operating at not over 15 lb steam and 30 lb water, having unflanged heads, may the provisions of Par. H-24 be applied? If not, what would the requirements be with respect to the area to be stayed and what would be the maximum height of the segment above the tubes?

Reply: *a* The provisions of Par. P-216 may be applied to the design of low-pressure heating boilers having flanged heads.

b Excepting only the allowance of 2 in. above the tubes, the provisions of Par. H-24 may not be applied to the unflanged flat heads of welded heating boilers. For unflanged flat heads in low-pressure heating boilers operating at not over 15 lb steam and 30 lb water, attached to the shell by any of the methods shown in Fig. 31, staying is not required if the height of the segment between edge of tube hole and the underside of shell does not exceed $1.25p$.

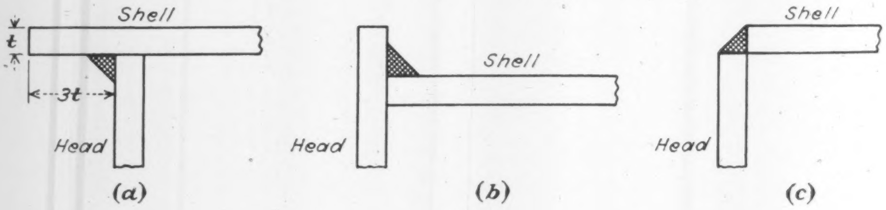

FIG. 31

CASE No. 847

(*Interpretation of Table P-5*)

Inquiry: For fire tubes, less than 1 in. in diameter, is it permissible in figuring the allowable working pressure in accordance with the formula given in Table P-5 revised, as adopted on August 31, 1937, to take credit for a copper cladding 0.033 in. in thickness on the outside of the tube, the cladding being on the water side of the tube and both it and the steel tube being in compression so that resistance to collapse is increased by the copper cladding.

Reply: It is the opinion of the committee that "t" in the formula may, for the case cited of a copper cladding, be increased by half the thickness of the cladding, providing the steel tubes otherwise meet the code requirements

CASE No. 848

(*Interpretation of Par. U-69*)

Inquiry: Par. U-69 of the code specifies that welding operators be requalified every six months by welding $^{1}/_{4}$-in., $^{5}/_{8}$-in., and $1^{1}/_{2}$-in. plate specimens, cutting from them the usual tension, nick-break, and bend-test coupons, and testing them. Would it be permissible to substitute a practice of welding, with each Par. U-69 vessel, a set of test plates of the same material and thickness as the shell, using the same procedure and the same type of groove as for the shell, the welding to be done by any qualified operator? It is understood that the initial qualification of a welding operator would be carried out in strict accordance with the present rules in Par. U-69.

Reply: It is the opinion of the committee that the initial qualification and requalification of welding operators should be carried out in accordance with Par. U-69, when the operators have not welded for a period of six months or more. A test plate attached to the end of the longitudinal joint will be accepted for the usual tension, nick-break, and bend-test specimens in lieu of the requalification tests required in Par. U-69, provided each operator has welded test plates of the required thickness within a period of six months.

REVIEWS OF BOOKS

And Notes on Books Received in the Engineering Societies Library

A Saga of the Seas

A Saga of the Seas: The Story of Cyrus W. Field and the Laying of the First Atlantic Cable. By Philip B. McDonald. Wilson-Erickson, Inc., New York, N. Y., 1937. Library buckram, $6^1/_4 \times 9^1/_4$ in., 288 pp., illustrated, $3.

Reviewed by Crosby Field[1]

AUTOMATICITY has so become the fetish of our age that few of us pause to think that machine is not automatically born of machine. The Atlantic Cable, although an epic in itself, was only one of several important achievements in the life of a great American, and Mr. McDonald wisely emphasizes throughout this book the human side of the subject. He gives us enough material for several biographies, and so versatile is the man about whom he is writing that each biography could well be of a different man—and each man a type story.

Thus, in the first two chapters, we have a true success story beloved of our present popular magazines but with a consummation so quick that Horatio Alger himself appears to have written it. A poor country boy, leaving home at 16, he retires at 33 as a wealthy merchant of New York City, worth well over a quarter of a million dollars which was a fortune for those days, and with a lovely wife, four daughters, a son, and a well-established reputation for business virtues based fundamentally on his minister-father's teachings.

Then followed a period of travel through America, Europe, and South America, and meeting with many persons of note, from Jenny Lind to George Bancroft. His ready acceptance as friend by all he met, scientist, politician, statesman, or worker, bears witness to a catholicity of interest and a self-education that would bear the scrutiny of the best that Europe could offer in either social or formal education. The biography of the "second" man covering many years, could well be that of a professional traveler, and his letters rank well as examples of reportorial art.

The "third" biography so well illustrates the life of an inventor that it might well be called typical. McDonald graphically marshals his facts and builds up an epic poem in prose of the fight of one man against fate. Starting with the third chapter, "The Simple Idea of an Atlantic Cable," Field pits his fortune, his optimistic promotional ability, and his great idea against the entrenched host of contrary scientific opinion. The great names of science and engineering, then as now, spent their time proving the cable's infeasibility, instead of assisting the project by their experience. Lesser names, favorable to Field, rode their hobbies and, by forcing their ideas on Field, ruined the operation of the first cable—as specialists always do to anything new. The thrills of the fight against public apathy, professional jealousy, political opportunism, inadequacies of materials and technological knowledge, economic chaos, the pause occasioned by the entrance of the War-God, the faltering faith of investors, the ups and downs of popularity, domestic and private business difficulties, are all well-told, and weighed in their telling. Draft riots, Gettysburg, possible recognition of the Confederacy by England, all throw their strength against the cable, as does the burning of Field's warehouse.

It would not be fair to deprive the reader of the opportunity to live through with Field and McDonald the actual laying of the cable, an entrancing narrative. The author missed only one opportunity of drama—the full story of the building of the *Great Eastern*, the friendship of Field and Brunel, the technical perfection of the great naval architect, the ship's commercial failure, the architect's tragic death—his failure, the foundation of his cable-laying friend's success. And so this third biography, the biography of struggle, ends with Field at 47 years old, with wife, four daughters, two sons, and a name high in achievement.

The 12th chapter starts the fourth biography, the story of an international figure, highly honored by many countries, including his own, to which he was able to be of many not small but frequently unusual services, several of which are told. Medals and honors poured in, he truly "walked with kings."

Other projects of Field then follow, of which the most lasting was the development of rapid transit in New York City, especially the elevated railroads. Then a dash into newspaper ownership—and out again.

After many ups and downs Field's final financial catastrophe at the hands of two good friends, Jay Gould and Russell Sage, provides the material for several New Deal outcries. And so at 68, Field steps down, permanently, and awaits the four-year-off end. His life "showed courage, initiative, and determination," but these qualities were no match for the sharp shrewd money changer, who now entered to reap the harvest sowed by such men as Field. As McDonald warns us at the beginning of the book, "This is one of the lessons of his life, that virtues carried too far become weaknesses."

To understand our times we must know the life, aims, and visions of the men of heroic stature of the age that went just before. And in the authentic portrayal of "Cyrus (the Great)" West Field, the author has done us a real service and has done it well.

Theory and Performance of Axial-Flow Fans

The Theory and Performance of Axial-Flow Fans. By Curt Keller; adapted for the use of fan designers by Lionel S. Marks with the assistance of John R. Weske. McGraw-Hill Book Company, Inc., New York, N. Y., and London, England, 1937. Cloth, 6 × 9 in., 140 pp., 112 figs., $4.

Reviewed by Theodore Baumeister, Jr.[2]

PROFESSORS Marks and Weske are to be commended for making available a text on the propeller-type fan. The literature in this field is all too sparse as will become evident to any engineer seeking performance, design, or selection data. In fact, the book under review constitutes the only reference devoted exclusively to the subject which has come to the reviewer's attention. It is timely because many fan designers and users are growing more conscious of the potentialities of the axial-flow blower for many service applications. In this respect, the propeller blower has many desirable features, but numerous difficulties have not yet been surmounted so that the propeller-type fan has not found its complete field of propriety. The factual and theoretical data contained in the book will do much to assist in the development of the axial-flow fan.

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[1] President, Flakice Corporation, Brooklyn, N. Y. Mem. A.S.M.E.

[2] Assistant Professor of Mechanical Engineering, Columbia University, and Consulting Mechanical Engineer, New York, N. Y. Mem. A.S.M.E.

The subject treatment is in two steps. The first part of the book develops many theoretical relations, while the latter part gives numerous experimental results to verify the theoretical considerations. The entire treatment is from the viewpoint of modern aerodynamics. In this respect the data from the aeronautics field are of utility. It is difficult to understand why these data should not long ago have been put to use in the design of fans and blowers as they have been for the design of airplanes and airplane propellers. The authors thus make full use of lift and drag data and all their implications, including such useful theories as those of circulation. They have wisely adopted, from aerodynamics, the convenient tool of dimensionless coefficients. Capacity, pressure, horsepower, and specific speed are thus typically expressed. It is to be hoped that others writing on fluid-dynamic machinery will likewise adopt the coefficient basis of expressing performance. It has many possibilities—evident in aeronautics—but apparently not realized elsewhere. The present text does much to show the use to which the coefficient basis of plotting can be put. The authors have left the underlying data in their original metric dimensions, which is unfortunate, because a sense of values does not come into full play for the American engineer. The adherence, likewise, to the European symbols—using Greek letters to a large extent, for instance—is also another case where the text often proves difficult reading. It is doubtful, however, whether these conversions would have justified the labor involved. Despite these minor criticisms, the reader must realize that the road to knowledge is rough and the authors have made a contribution on the theory and performance of propeller blowers, which should be studied with care. Books of this type are only too rare in the library of the American engineer because they are not available.

Books Received in Library

BRITISH NON-FERROUS METALS RESEARCH ASSOCIATION. Research Report No. 18 (Association Series No. 440, June, 1937). PROPERTIES OF LEAD AND LEAD ALLOYS. The Association, London. Paper, 6 × 10 in., 7 pp., tables, 2s. This report summarizes the data upon the fatigue resistance of lead and its alloys obtained during the research work of the Association. The materials covered include lead in various conditions and degrees of purity, and lead with small additions of various metals and groups of metals. A few tests at 100 C are included, and some showing the effects of surrounding media and protective coatings.

DAVISON'S TEXTILE BLUE BOOK, United States, Canada and Mexico. Seventy-second year, 1937. Davison Publishing Co., New York. Cloth, 5 × 8 in., 1323 pp., $5. An annual publication containing lists of manufacturers of cotton, rayon, silk, and knit goods, and of dyers and finishers, geographically arranged. Commission merchants, dealers, and importers are listed, also domestic and foreign raw-cotton firms, cotton compresses, and warehouses. Two special lists cover pertinent associations and railroads serving the various mills.

DIN NORMBLATT-VERZEICHNIS 1937. Edited by Deutscher Normenausschuss. Beuth-Verlag, Berlin. Paper, 6 × 8 in., 358 pp., illus., charts, tables, 3.33 rm. This volume provides a comprehensive catalog of the specifications, definitions, practices, and other standards issued by German standardizing bodies through the Deutsche Normenausschuss. The standards are classified according to the Universal Decimal classification, and in addition there is a numerical list and an index.

Deutsches Museum Abhandlungen und Berichte, Jg. 9, Heft 3, 1937. DIE ENTWICKLUNG DES KRAFTFAHRZEUGS, by W. Kamm. V.D.I. Verlag, Berlin, 1937. Paper, 6 × 8 in., 74 pp., illus., 0.90 rm. A brief history of the development of the automobile, considering in particular the work of Daimler and Benz. In closing, the probable future development is touched upon, stressing simplification.

EIGNUNG VON SPEISEWASSERAUFBEREITUNGSANLAGEN IM DAMPFKESSELBETRIEB. Edited by Arbeitsgemeinschaft Deutscher Kraft- und Wärmeingenieure (ADK) des V.D.I. Verlag, Berlin, 1937. Paper, 6 × 8 in., 88 pp., diagrams, charts, tables, 5.75 rm. A discussion of the functions of a feedwater-treatment plant in steam-boiler operation, covering fundamentals, evaporators, heat exchangers, softening, and degassing. This is the first of a number of pamphlets to be published on the subject of feedwater-treatment plants.

EVERYDAY SCIENCE. By A. W. Haslett. Alfred A. Knopf, New York, 1937. Cloth, 6 × 9 in., 305 pp., $2.75. Several books have been written on the effect of scientific research on everyday life. This particular one is intended to give the layman definite, factual information on various phases of research and provide a solid background on which to base opinion and discussion; thereby removing the subject from the realm of mystery and wonder by furnishing comprehensible examples.

ENGINEERING PROBLEMS MANUAL. By F. C. Dana and E. H. Willmarth. Third edition. McGraw-Hill Book Co., New York and London, 1937. Cloth, 5 × 8 in., 313 pp., diagrams, charts, tables, $2.25. A textbook for use in courses on engineering problems which have for their object the training of the engineering student in good habits of work and study. The first seven chapters provide information which will furnish a groundwork for this training. Chapter 8 presents some three hundred practical review problems, and miscellaneous tables helpful for their solution are given in Chapter 9.

FACTORY EQUIPMENT. By J. W. Roe and C. W. Lytle. Second edition. International Textbook Co., Scranton, Pa., 1937. Leather, 5 × 9 in., 517 pp., illus., diagrams, charts, tables, $4. This book is designed to fill the gap between the theoretical treatment of tool processes and the volumes that cover practical tool operations in detail. It discusses production machinery mainly from the point of view of its selection or its application for economic production. There are references and sample questions at the end of each chapter.

Great Britain. Science Museum. INTERPRETIVE HISTORY OF FLIGHT, by M. J. B. Davy. London, His Majesty's Stationery Office, 1937. Paper, 6 × 10 in., 207 pp., illus., diagrams, paper, $1.50. The purpose of this book is to explain the outstanding phases, facts, and events in the history of aeronautics, in the light of contemporary human development. Part I covers the origins of flight by humans; Part II, the succeeding developmental stages of airships, gliders, and powered airplanes; Part III discusses the modern phases, including the social and economic significance of flight.

PETROLEUM TECHNOLOGY IN 1936. Edited by F. H. Garner. Institution of Petroleum Technologists, London, 1937. Cloth, 6 × 9 in., 326 pp., illus., diagrams, charts, tables, 8s. postage included. A collection of reviews of progress in the various branches of the oil industry during 1936. All branches are covered: Geology, geophysics, production, transportation and storage, ocean transport, refining, cracking, petroleum gases, distillates, engine fuels, lubricants, road materials. References to sources of information are given. The book is a compact, valuable reference book.

PHYSICS FOR STUDENTS OF APPLIED SCIENCE. By J. E. Shrader. McGraw-Hill Book Co., New York and London, 1937. Cloth, 6 × 9 in., 638 pp., illus., diagrams, charts, tables, $4. The purpose of this new textbook is to present, in logical sequence and concise form, those fundamentals which are necessary to give the technical student a working knowledge of physics. The arrangement of material, by which mechanics and heat are followed first by electricity and then by wave motion, sound and light, is that which seemed to the author most logical and best suited to the needs of the student for the pursuit of other subjects, especially in the field of engineering. There is a large group of problems at the end of each section.

PREPARATION FOR SEEKING EMPLOYMENT. By H. L. Davis. John Wiley & Sons, New York,

1937. Paper, 6 × 8 in., 39 pp., tables, $0.25. A pamphlet for the guidance of those who seek employment for themselves or others. The main thought expressed, as gained from the author's own experiences, is the necessity for knowing, at least approximately, what one wishes to do, definite instruction being given in the pamphlet toward that end.

Prüfen und Messen. Vorträge der vom Verein deutscher Ingenieure am 1. und 2. Dezember 1936 in Berlin veranstalteten Tagung. V.D.I. Verlag, Berlin, 1937. Paper, 8 × 12 in., 199 pp., illus., diagrams, charts, tables, 10 rm. A collection of papers presented at a conference on testing and measurement technique. Following two general papers come a number of more specific ones arranged under three main headings: Measurement and control in heat engineering; testing and measurement in the workshop; testing and measurement of machine parts as a basis for their design. There is also a note on an exhibition of measurement apparatus.

(The) Psychology of Selecting Employees. By D. A. Laird. Third edition. McGraw-Hill Book Co., New York and London, 1937 Cloth, 6 × 9 in., 316 pp., illus., diagrams, charts, tables, $4. A practical treatment of the fundamental considerations in selecting men. The book gives a comprehensive picture of psychological means and methods of selecting employees, and shows the employer how to find efficient employees in his own establishment, as well as in his employment office. The application of psychological principles in actual employment work is explained.

Richard Cockburn Maclaurin. By H. G. Pearson. The Macmillan Co., New York, 1937. Cloth, 6 × 9 in., 302 pp., illus., $3. A biography of the man who was president of the Massachusetts Institute of Technology, 1909 to 1920. Chiefly concerned with his work in that capacity, since it was under his administration that the Institute rose from a minor to a major educational institution.

A Saga of the Seas. By P. B. McDonald. Wilson-Erickson, New York, 1937. Cloth, 6 × 10 in., 288 pp., illus., $3. A biography of Cyrus W. Field, of which the greater part is devoted to his greatest achievement, the laying of the first Atlantic cable. Illustrated with contemporary prints and portraits.

Science Experiences With Home Equipment. By C. J. Lynde. International Textbook Co., Scranton, Pa., 1937. Leather, 5 × 8 in., 226 pp., diagrams, $1.25. A description of 200 experiments requiring very simple equipment and designed to illustrate various scientific phenomena. A brief explanation is given for each experiment.

Symposium on Lubricants (1937). Chicago Regional Meeting, American Society for Testing Materials, March 3, 1937. Published by the Society, Philadelphia. Paper, 6 × 9 in., 89 pp., illus., diagrams, charts, tables, $1.25, $1.50. The purpose of the symposium was to summarize and bring up to date the available information on motor oils and their applications (limited to motor-car engine lubricants). The four papers cover respectively: Engine deposits, effect of design and composition of automotive bearings on lubrication, addition agents for motor oils, and selection of motor oil from consumer's standpoint.

Technische Thermodynamik. Part 2. By F. Bosnjakovic. Dresden and Leipzig, Theodor Steinkopff, 1937. Leather and paper, 6 × 9 in., 294 pp. and 1 folder of heat tables, diagrams, charts, tables; paper, 18 rm; bound, 19 rm. Part 2 of the section on technical thermodynamics of a series covering the general subject of heat, both theoretically and practically. The present book treats mainly of binary mixtures of gases, liquids, or both, giving properties, technological processes, material exchanges, and equilibrium conditions. A separate supplementary folder contains heat and entropy charts for various mixtures.

A Textbook of Physics. By L. B. Spinney. Fifth edition. The Macmillan Co., New York, 1937. Cloth, 6 × 9 in., 721 pp., diagrams, charts, tables, $3.75. A textbook for university and college students which emphasizes the practical applications of physics and illustrates the laws by reference to familiar phenomena. This edition has been thoroughly revised and additions made where necessary to bring the material up to date.

Thermodynamics. By H. A. Everett. D. Van Nostrand Co., New York, 1937. Cloth, 6 × 9 in., 430 pp., diagrams, charts, tables, $3.75. A textbook for a college course. The fundamentals of the subject are covered thoroughly and various phases are discussed in the light of modern developments in the field.

V.D.I. Sonderheft, Feinmechanische Fertigung. V.D.I. Verlag, Berlin, 1937. Paper, 8 × 12 in., 36 pp., illus., diagrams, charts, tables, 3.50 rm. Reprints of articles on the production of precise parts which have appeared previously in *Zeitschrift V.D.I.* and *Maschinenbau.* The last article contains a list of 85 articles on the subject which have appeared within the last ten years.

THIS MONTH'S PAPERS *and* AUTHORS

A CENTURY ago engineers were almost exclusively master technicians and were building roads, bridges, and canals. This picture has changed and the engineer has now become much more than a master technician because of the increasing importance of management in industry and particularly in the crucial field of employer-employee relations. In the future, says Harvey N. Davis in his address before the National Metal Congress on "The Place of the Engineer in Modern Life," the engineer will be an industrial administrator, who will be concerned with balancing the general equities among clients, stockholders, and employees. The author, who has been elected president of A.S.M.E. for the next administrative year, is president of Stevens Institute of Technology, Hoboken, N. J., where, approximately forty years ago, economics of engineering was first included in the curriculum of any engineering school. Doctor Davis had been a teacher at Brown and Harvard Universities before coming to Stevens in 1928 and, during the World War, was active in the helium investigations that were conducted by the Army, the Navy, and the Bureau of Mines. He is probably best known as collaborator with L. S. Marks in "Tables and Diagrams of the Thermal Properties of Saturated and Superheated Steam," and for his own researches in this field.

CARBIDE-TIPPED TOOL GRINDING

Rapid economical production or restoration of keen cutting edges and the smoothest possible tool-chip work contact surfaces could not be attained with sintered carbide-tipped tools until special wheels having new and unusual characteristics were developed and suitable machines designed. Requirements of rough grinding, classes of finish-grinding, and uses of the cutter grinder are discussed in the paper "Grinding of Sintered Carbide-Tipped Tools," and data are presented on the wide range of machines and wheels available. Diamond wheels are best suited for tools of this type in the opinion of the author, Malcolm F. Judkins. His experience includes work with the Northwest Testing Laboratories, Seattle, Wash., during vacations while a student at the University of Washington and the Carnegie Institute of Technology, and metallurgical research work at the United States Bureau of Mines Experiment Station at Pittsburgh, Pa. In 1929, Mr. Judkins became an engineer in the Firthite Division of the Firth-Sterling Steel Company, McKeesport, Pa., and two years later was promoted to his present position of chief engineer of the division. He has contributed several articles to trade and technical journals and is a member of A.S.M.E. in addition to holding membership in the American Society for Metals, the American Society for Testing Materials, and the American Society of Tool Engineers.

PRINTED-TEXTILE MERCHANDISE

Continually fluctuating requirements that originate with consumers, retailers, garment manufacturers, and converters acting as interpreters or forecasters of consumer demand constitute the problem that must be solved by textile-printing establishments in marketing their product. Determining consumer style requirements, which is the major factor in this problem, months in advance of a season's opening requires various methods, and decisions are based on the merchandizers' observations and forecasts of how a certain group of people, whom they have studied, will react. S. J. Kennedy, in his paper "Merchandising Requirements of Printed Textiles," points out that the use of prints, which serve three customer requirements, is regulated by fashion and consumer psychology. All cloths must be merchandised for a specific use, which regulates size of design, size of the repeat, turning of the motif in the design, number of colors used, and their combination. For the last ten years, Mr. Kennedy has been associated with Pacific Mills, New York, N. Y., in an executive and research capacity. He also is chairman of the Committee for Textile Price Research of the Conference of Price Research, an organization that is sponsored by 11 leading research organizations and universities to study economic behavior of prices. In addition to articles in textile trade papers and magazines, Mr. Kennedy is the author of "Profits and Losses in Textiles," which was published last year and analyzes financing in the cotton-textile industry since 1919 with special emphasis upon the financing of large textile mergers.

PROBLEMS OF MOLDED-PLASTICS DESIGN

Close cooperation between the engineer-draftsman and the artist is necessary in designing products that are to be made from plastics, and the salient principle to be remembered, says D. M. BUCHANAN, is that the design must permit easy removal of the part from the mold after molding is completed. Certain basic details or design factors, such as wall thickness, allowances and tolerances, inserts and fastenings, threads, fillets, knurling, lettering and engraving, and finish, are discussed in the paper "Design Problems of Molded Plastic Parts," which points out that their correct handling will do much to assist in perfect development of the problem. The author, who has been sales engineer with the Bakelite Corporation, New York, N. Y., since 1926, holds an M.E. degree from the Polytechnic Institute of Brooklyn. For the first ten years of his business career, he was associated with the tool-design and production departments of several manufacturing organizations. In 1921, Mr. Buchanan was emyloyed in the tool methods department of the Western Electric Company and later became personnel manager of its installation department, remaining there until 1924. This was followed by one year as employment manager and assistant factory manager with the De Forest Radio Company and a similar engagement with the Ware Radio Corporation as employment and personnel manager, after which he formed his present connection.

DECORATIVE PLASTICS

Only within the last ten years have the eye-appeal possibilities of plastics received serious consideration as, prior to that time, they were used almost exclusively for practical and mechanical industrial applications. Lack of public acceptance of plastics as a dignified material for objects of beauty is attributed by ROBERT J. HILL to a cheap market, poor designing, and cheap molding, all of which were encouraged by the materials manufacturers. Although the author subscribes, in general, to the belief that the machine can never supplant the art of the craftsman, he points out that, while the craftsman can only bring art and beauty to the few, the machine can supply beauty for all, and the paper "Art in Plastics Design" points out that uses of plastics are growing because the many materials available in all the colors, hues, and shades of the spectrum afford boundless opportunities for the artist to make his contribution of beauty to satisfy human needs. The author, who is art director of the plastics and bronze divisions of The Gorham Company, Providence, R. I., tells us that he left school to become a newspaper artist on the New Haven *Union* where he was fired for not being amusing. He adds that since that time he has been on the verge of being fired many times for being too amusing! He has worked in every design department of The Gorham Company and has produced many trophies in silver, bronze, and plastics, as well as silverware, ecclesiastical ware, and sculptural and architectural bronzes and plastics.

PLASTICS MATERIALS

According to HARRY BURRELL, author of the paper "Plastics Materials," anything that can be deformed under mechanical stress without loss of coherence and retain the new form is a plastic. The modern plastics industry has a wide range of materials from which to make a selection for a particular application. Common organic plastics in commercial use include synthetic resins, cellulose derivatives, rubber and its substitutes, shellac, casein, and bitumens, and the choice is ultimately decided by selecting the material that will perform the service satisfactorily and cheapest. Fitness of a given plastic can be predicted with reasonable accuracy from the data contained in publications of the various manufacturers so that the question becomes one of cost finding for the few principal contenders. Mr. Burrell was graduated from the Newark College of Engineering with the degree of B.S. in chemical engineering in 1934. Since graduation, he has been engaged in research on synthetic resins and patent work and is now associated with the Ellis-Foster Company, Montclair, N. J. He is a member of the American Chemical Society.

A TIMELY REMINDER

An optimist in habit and from conviction, WILLIAM D. ENNIS says that the facts now visible afford, for the moment, little basis for persistent hopefulness. His paper entitled "Forgotten Economic Facts" discusses such topics as sharing wealth, equalization of income, inflation, labor and wages, majority rule, and economic planning. The author is a consulting engineer, economist, Treasurer of The American Society of Mechanical Engineers, and Alexander Crombie Humphreys professor of economics of engineering at Stevens Institute of Technology since 1928. He was graduated from Stevens in 1897 and his engineering career has embraced professional and industrial practice as well as professorships at the Polytechnic Institute of Brooklyn, Columbia University, and the United States Naval Academy. Professor Ennis has written books on thermodynamics and industrial management, fields in which he has taught for many years, and on numerous other subjects including lubrication and motor-vehicle taxation. He has given considerable study to the financial and economic aspects of engineering, has practiced widely in this field, and his recent contributions to MECHANICAL ENGINEERING have dealt with this subject.

ALUMINUM TANKS FOR AIRCRAFT

Aircraft fuel tanks can be fabricated from aluminum by either the spot or the seam method of electric-resistance welding as the latter is merely an extension of the former because it consists of a series of overlapping spots that make a continuous leakproof seam. According to the paper "Spot- and Seam-Welded Aluminum Tanks for Aircraft," spot welding can be used for joining structural parts and fastening the skin of the tank to the baffle structure in much the same manner as rivets are used, but with the elimination of probable causes of leaks, as holes through the skin sheet are unnecessary; and the further advantage that the exterior surface is smooth and free from projecting rivetheads. F. V. HARTMAN says that each tank is a problem in itself because of the many variables, such as baffle and stiffener constructions, involved and no two tanks can be handled alike. The author, who is an A.S.M.E. member, was graduated from the University of Kansas in 1915 with the degree of B.S. in mechanical engineering. After a varied career that included testing airplane materials at the United States Bureau of Standards for two years and service in the Navy during the World War, he became associated with the Aluminum Company of America, New Kensington, Pa., in 1919 and was promoted to his present position of mechanical engineer in 1928.

ACCIDENT PREVENTION BY JOB TRAINING

Foremen play an important part in accident prevention because men take their cue regarding safety from their foreman and the effectiveness of a safety program will not rise much above the level of management's active interest and participation. The paper "Adequate Job Training for Accident Prevention," by GLENN L. GARDINER, points out that the foreman must take a number of definite steps to eliminate accidents on operations that he supervises, the most important one being the careful and thorough instruction of every new man and every old man on a new job with reference to every possible hazard connected with the job. This should be supplemented by a continuous process of safety education and systematic safety contacts with each worker as well as establishment of safety discipline and regular and systematic inspection.

Effective accident prevention has some worth-while by-products such as greater efficiency and improved quality of workmanship, decreased breakage and damage to tools and materials, and increased cooperation among workers. Mr. Gardiner, who is assistant to the president of the Forstmann Woolen Company, Passaic, N. J., was educated at the University of Wisconsin and has been associated with the Chevrolet and Oakland factory organizations. He was author and supervisor of the University of Wisconsin extension courses in foremanship and factory management and a similar course in modern foremanship at Columbia University and has written over 30 books on industrial and related subjects. Mr. Gardiner was vice-president of the American Management Association from 1934 to 1936 and has served as general manager of the Manufacturers Foundation.

A.S.M.E. NEWS

And Notes on Other Engineering Activities

Humming Birds, Golf Balls, Apes, and Engineers, Features of the A.S.M.E. Annual Meeting

High Lights of Nontechnical Features

HIGH LIGHTS of some of the nontechnical features of the 1937 Annual Meeting of The American Society of Mechanical Engineers, to be held in New York, Dec. 6 to 10, have developed since the November issue as plans of the Committee on Meetings and Program take shape.

Dinner Will Draw a Large Crowd

The Annual Dinner, Reception, and Dance of the Society, to be held as usual on Wednesday evening at the Hotel Astor, is so well-known and enthusiastically anticipated by members who have attended the event in years past that little urging is required to turn out a large crowd. This year James H. Herron, president, will act as toastmaster and will speak briefly on "Professional Unity."

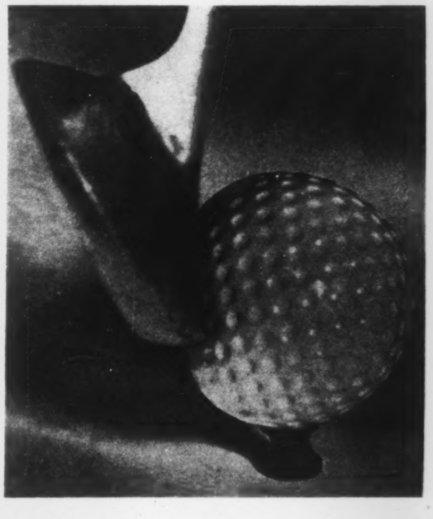
Nine persons whose membership in the Society has reached the 50-year mark will be honored by the Society by receiving the usual 50-year membership badge at the hands of the president.

Speaking on the Towne Lectureship, Dr. Earnest A. Hooton, anthropologist, Peabody Museum, Harvard University, will deliver the principal address at the dinner. The subject of Doctor Hooton's address will be "The Simian Basis of Human Mechanics, or Ape to Engineer." The distinguished scientist has recently published a book of essays called "Apes, Men, and Morons" which has won for him a reputation for keen wit as well as knowledge of anthropology. His address promises to be not only instructive but entertaining.

Rice Memorial Tablet to Be Unveiled

Most recent of the events to be scheduled is the unveiling of the Calvin W. Rice Memorial, a bronze tablet which will be placed in the entrance hall of the Engineering Societies Building after the required interval of five years following the death of the person memorialized has elapsed. The tablet will be placed on an easel on the platform of the auditorium and will be unveiled by D. Robert Yarnall, president, United Engineering Trustees, the custodians of the building. The tablet bears a portrait in bas-relief of the late Calvin W. Rice, for more than a quarter century secretary of the A.S.M.E., and a suitable inscription commemorating Mr. Rice's services to the engineering profession and his part, as chairman of the building committee of the American Institute of Electrical Engineers, in securing, in 1903, the gift by Andrew Carnegie which made possible the present headquarters of the Founder Societies, the Engineering Societies Building. The tablet was executed for the United Engineering Trustees by Gaetano Cecere, sculptor, and under the direction of a committee of the trustees consisting of W. L. Batt, chairman, Otis E. Hovey, George D. Barron, and G. L. Knight.

The unveiling of the Rice tablet will take place on Honors Night, Tuesday, December 7. That same evening honorary membership will be conferred on Lorenzo Allievi, of Rome, Italy, eminent hydraulic engineer, whose 81st birthday was celebrated on Nov. 18, 1937. Because Signor Allievi is prevented by age and distance from being present in person, a representative of the Italian government will receive the certificate of honorary membership in his name from the hand of James H. Herron, president, A.S.M.E., who will preside on Honors Night.



HIGH-SPEED CAMERA CATCHES GOLF BALL BEFORE IT LEAVES THE TEE

Medals to Be Presented

In addition to these unusual features of Honors Night, the Society's awards for 1937 will be conferred on their recipients, The Holley Medal is to be conferred on Frederick G. Cottrell, the A.S.M.E. Medal on Edward P. Bullard, the Worcester Reed Warner Medal on Clarence F. Hirshfeld, the Melville Medal on Alfred J. Buchi, the Junior Award to Leslie J. Hooper, Charles T. Main Award to Allen P. Stern, and Student Award to Gino J. Marinelli.

Announcement of the results of the balloting for Society officers for 1937–1938 will be read on Honors Night also and President-Elect Harvey N. Davis will be escorted to the platform to greet members of the Society.

R. Merwin Horn, of the Massachusetts Institute of Technology, 1937 Thurston Lecturer, will deliver an illustrated address on Honors Night. His subject is "Seeing the Unseen." The address deals with some of the results of several years' work on high-speed photography obtained by Prof. Harold E. Edgerton and his associates at M.I.T. It will be illustrated with motion pictures taken with the high-speed camera at speeds as high as 6000 frames per second. The pictures show clearly the action of humming birds' wings, objects breaking, and what happens when a golf ball is hit, and when a football is kicked.

President's Address

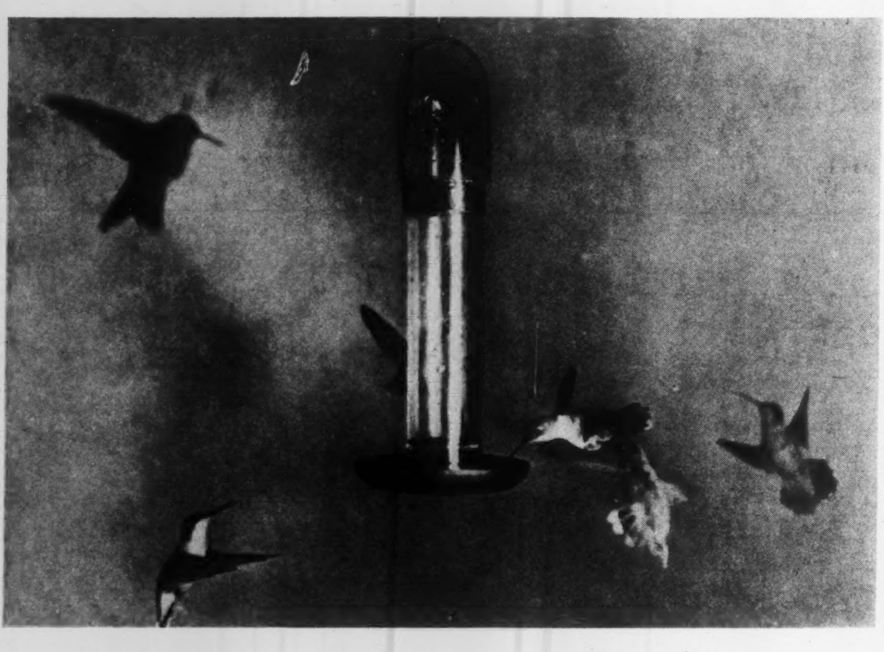
Members of the Society will want to make it a point to be on hand at the Auditorium on Monday afternoon, Dec. 6, at 4 p.m., when the Annual Business Meeting of the Society will be held. The annual reports of the Council will be presented at this time, and the usual business of the Society will be conducted.

President Herron will deliver the presidential address at the Business Meeting. For his address Mr. Herron has chosen the title "Retrospection and Prospection."

Junior and Student Members Urged to Attend Dance

At the reception held immediately following the dinner, members will have an opportunity to meet President and Mrs. James H. Herron, President-Elect and Mrs. Harvey N. Davis, and Secretary and Mrs. C. E. Davies. Dancing will follow the reception.

Junior and student members of the Society who do not attend the dinner will be admitted



HUMMING BIRDS' WINGS STOPPED IN FLIGHT BY HIGH-SPEED CAMERA

by ticket to the galleries of the ballroom in time to hear the addresses following the dinner. Admission will also afford them an opportunity to attend the reception and take part in the dancing. The price of these tickets has been set at $1.50. They will be issued to junior and student members, and their guests, only.

Since last year the ballroom of the Hotel Astor has been completely redecorated but the familiar scene of the Society's annual social event, with the opportunity it provides for the meeting of old friends in an atmosphere of good fellowship and traditionally superior entertainment will make every member feel at home and remind him of former years spent in these surroundings.

Technical Program Change

Attention is called to an important change in the technical program as announced in the November issue. Two sessions, the one originally scheduled for Tuesday afternoon on "High-Temperature Joints," and the Power session on Wednesday morning have been interchanged. The session on "High-Temperature Joints" will be held on Wednesday morning, and the Power session on Tuesday afternoon.

Evening Technical Sessions

For the benefit of a large group of Society members who find it difficult or impossible to get away from their jobs during the day, several technical sessions have been arranged for Monday and Thursday evenings. Experience at the 1937 Semi-Annual Meeting at Detroit demonstrated how popular these evening sessions are, and in recent years they have been tried at Annual Meetings with the result of attracting large audiences. This year's program lists two sessions on Monday night, one on labor's attitude toward time and motion study, and the other on machine-shop practice at which papers on measurement of surface roughness and the grinding of carbide-tipped tools will be read. The Thursday evening sessions are three in number and are sponsored by the Aeronautics, Oil and Gas Power, and Railroad Divisions.

Excellent Papers at Joint Session of Machine Shop and A.W.S.

As a PART of the National Metals Congress held in Atlantic City, N. J., during the week of October 18, the Machine-Shop Practice Division of the A.S.M.E. and the American Welding Society held an interesting joint session on Tuesday afternoon.

G. F. Nordenholt, chairman of the Machine-Shop Practice Division presided and J. W. Sheffer of the American Car and Foundry Co., served as vice-chairman. Three papers were presented, as follows:

"Resistance-Welding Fabrication," by J. M. Cooper

"Developments in Large Welded Structures," by C. C. Brinton

"Recent Developments in Fusion Welding," by C. W. Obert

Mr. Obert's paper was published in the November issue of MECHANICAL ENGINEERING, pages 805–808. The papers by Mr. Brinton and Mr. Cooper are scheduled for publication in an early issue. The session was exceptionally well attended and the discussion a lively one.

At a joint dinner of the A.I.M.E. and the Machine Shop Practice Division held on Wednesday evening, October 20, A.S.M.E. President-elect Harvey N. Davis was the principal speaker. His address on "The Place of the Engineer in Modern Life" appears as the leading article in this issue.

Committee on Plastics Plans Organization Meeting

On TUESDAY, December 7, at 2:00 p.m. a conference will be held in room 1101 in the Engineering Societies Building, New York, N. Y., to discuss the organization of a Committee on Plastics and Rubber, a subcommittee of the Process Industries Division. The chairman of this committee has been appointed by the Division, Felix L. Yerzley, of the rubber laboratory of E. I. du Pont de Nemours & Co., Inc., and the secretary, J. F. Downie Smith, of the research department of the Budd Manufacturing Co., Philadelphia, Pa.

Members who may be interested in attending the organization meeting of this committee during the Annual Meeting are requested to communicate directly with the secretary of the committeee.

College Reunions During A.S.M.E. Annual Meeting

THE FOLLOWING reunions of alumni are being planned for Thursday evening, December 9, during the A.S.M.E. Annual Meeting in New York. Full details of these reunions will appear in the formal printed program to be distributed at the meeting.

Brooklyn Polytechnic Institute

December 9. 7:00 p.m. A Smoker is being arranged to be held at Brooklyn Polytechnic Institute. Speaker to be announced later.

Massachusetts Institute of Technology

December 9. Hotel Astor at 6:45 p.m. Speakers will be Dr. Karl T. Compton, Gerard Swope, Senator Thomas Desmond, and W. K. Lewis.

Rose Polytechnic Institute

December 9. Advertising Club of New York, 23 Park Avenue, at 6:00 p.m.

Stevens Institute of Technology

December 9. Roger Smith Restaurant, at 6:30 p.m.

Purdue University

December 9. Building Trades Employees Association, Room 8, at 6:30 p.m.

Worcester Polytechnic Institute

December 9. Machinery Club., at 6:30 p.m.

Change in A.S.M.E. Annual Meeting Program

THE session on High-Temperature Joints which was scheduled for Tuesday afternoon, December 7, in the program for the 1937 Annual Meeting published in our November issue, pages 870 and 871, has been changed to Wednesday morning, December 8.

The session on power originally scheduled for Wednesday morning will be held on Tuesday afternoon.

Producer-Consumer Cooperation Stressed at Coal Meeting at Pittsburgh

Continuance of Similar Meetings Favored

PREPARATION and use of coal was the theme of the first joint meeting that was held by the Fuels Division of the Society and the Coal Division of the American Institute of Mining and Metallurgical Engineers at the William Penn Hotel, Pittsburgh, Pa., on Oct. 27 and 28. This meeting was epochal in many ways and proved that producers and consumers of coal are willing to cooperate in an attempt to solve their joint problems. It was the first time that any two organizations which were representative of their respective groups had met, and an attendance of approximately 300 shows how well the meeting met a popular demand. About 40 per cent of those attending were not members of either organization, which also serves to emphasize the need for leadership in reaching a better understanding of consumer requirements so that producers might know what conditions they should try to meet in preparing their products.

On the evening of Oct. 27, a dinner meeting was held which was attended by the executive committee and the chairmen of the technical committees of the Fuels Division of the Society and corresponding members of the Coal Division of the American Institute of Mining and Metallurgical Engineers. After expressions of opinion regarding the desirability of holding other joint meetings in the future were given by those representing producers and consumers and some favorable comments were also made by representatives of government agencies and other interested organizations, the following resolution was adopted:

Be it resolved, By the Fuels Division of The American Society of Mechanical Engineers and the Coal Division of the American Institute of Mining and Metallurgical Engineers, Inc., that, due to the interest shown in this joint meeting of these Divisions of these Societies, we favor the continuance of similar joint meetings designed to promote further cooperation between the engineers of consumers and the producers of coal.

The program, which was printed in the October issue of MECHANICAL ENGINEERING on page 789, included technical sessions in the morning and afternoon of each day, a safety session in the afternoon of the second day, the dinner meeting that was mentioned in the preceding paragraph, and a banquet on the final night of the meeting. Publication of the proceedings of the meeting in a book of approximately 60 pages, $8\frac{1}{2} \times 11$ in. in size, about one third of which would be discussion, is now being considered. To obtain some idea regarding the possibility of financing this publication, all who have not already expressed themselves in writing are requested to inform the Secretary's office as to how many copies of the proceedings they would purchase at a charge of $1 for single copies or $2 for three copies. For the convenience of those interested, a coupon is printed elsewhere on this page. Prompt responses are requested so that an early decision may be reached.

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Secretary's Office,
A.S.M.E.,
29 West 39th St.,
New York, N. Y.

If the proceedings of the Coal Meeting of Oct. 27 and 28, 1937 are published, I will purchase .... copy (copies) at $1 for single copies and $2 for lots of three copies.

Name..

Address..

"Journal of Applied Physics" Available to A.S.M.E. Members

BELIEVING that the range of interest in *The Journal of Applied Physics* extends beyond the members of the founder societies of the American Institute of Physics, its governing board recently voted to extend to the members of The American Society of Mechanical Engineers the privilege of subscribing to it at the special rate of $5 a year.

The Journal of Applied Physics is a nonprofit-making cooperative effort on the part of those applying physics in industry and in other sciences to keep abreast of modern developments and recent applications of physics. Besides publishing general reviews, it includes also original research contributions in all phases of applied physics.

For more detailed information on the journal please communicate directly with the American Institute of Physics, 175 Fifth Avenue, New York, N. Y.

A.S.M.E. Textile Division Hears Three Interesting Papers by P. A. Merriam, B. R. Andrews, and A. W. Benoit

UNDER THE joint auspices of the Textile Division and the Boston Section, a textile meeting was held at Boston on Oct. 15, 1937. The program included a visit to the plant of the Hood Rubber Company, Inc., in the morning, luncheon at Massachusetts Institute of Technology, and an afternoon technical session at which three papers were presented to an interested audience of more than fifty.

Approximately thirty-five members participated in the inspection trip to the plant of the Hood Rubber Company, Inc., at Watertown, Mass. Here they saw the various steps involved in the manufacture of canvas and waterproof footwear and a line of miscellaneous rubber products.

Following the inspection trip, luncheon was served in North Hall of the Walker Memorial at Massachusetts Institute of Technology, Cambridge. The afternoon session, which was also held in North Hall, was opened with an address of welcome by James Holt, assistant professor of mechanical engineering at the Institute, as a substitute for B. B. Folger, chairman of the Boston Section, who could not be present. At the conclusion of his remarks, Professor Holt introduced A. W. Benoit, chairman of the Textile Division, who presided at the meeting. Officers of the Division for next year, Charles T. Main, Prof. E. R. Schwarz, M. A. Golrick, Jr., H. D. Learnard, and J. J. McElroy, were introduced by Mr. Benoit.

Paul A. Merriam presented the first of the three papers of the session, "Recent Developments in Wet Finishing and Dyeing Machinery," which dealt briefly with the introduction of the range or continuous method and the application of stainless steel to the machinery used for fulling, washing, and dyeing woolen and worsted piece goods. The second paper, "Temperature in Drying," by B. R. Andrews summarized research work that has been done recently on drying temperatures and their effect on the finishing of goods. Mr. Benoit then presented the concluding paper, "Some Comments on the Growth of the Cotton Spindleage in This Country and Its Future," which pointed out that the number of spindles increased continuously from 10 million in 1880 to 38 million in 1925 and then declined to slightly less than 28 million on Jan. 1, 1937, with approximately 87 per cent of these active. On the basis of the trend in the last 11 years, the number of spindles scrapped in 1936, and the tendency to operate spindles for a greater number of hours, Mr. Benoit believes that several million more spindles must be scrapped before the industry is stabilized and stated that 23 million spindles in place would not be an unreasonable expectation when that condition was attained.

Wanted: Reminiscences of Edward Weston

MR. Allan R. Cullimore, mem. A.S.M.E., President of the Newark College of Enneering, is gathering material for a biography of Dr. Edward Weston, the noted scientist and manufacturer of electrical-measuring instruments.

While much information is available concerning Dr. Weston, Mr. Cullimore would appreciate receiving reminiscences, letters, copies of letters, or any other information concerning Dr. Weston. The thousands who knew him, either personally or officially, unquestionably have much to offer.

All communications should be addressed to President Allan R. Cullimore at the Newark College of Engineering, Newark, New Jersey. Any original letters or manuscripts submitted will be preserved carefully and returned.

A.S.M.E. Calendar

of Coming Meetings

December 6–10, 1937
Annual Meeting
New York, N. Y.

March 23–25, 1938
National Spring Meeting
Los Angeles, Calif.

May 4–6, 1938
Machine Shop Practice Meeting
Rochester, N. Y.

June 20–24, 1938
Semi-Annual Meeting
St. Louis, Mo.

F. A. Lockwood, A.S.M.E. Delegate, Reports on Centenary Celebration of Swiss Society of Engineers

Enthusiastic Over Well-Handled Events

ABOUT a thousand persons attended the centenary celebration of the Swiss Society of Engineers and Architects held at Berne, Switzerland, September 4 to 7, 1937, including delegates of some forty foreign engineering societies. The A.S.M.E. was ably represented by its official delegate and member, Frank A. Lockwood, of Vevey, Switzerland, who has sent us a most interesting account.

The celebration opened on Saturday, September 4, with services in the Berne Cathedral at which members of the Swiss Cabinet and foreign delegates were given seats of honor. After the invocation by the pastor of the cathedral, the Reverend P. Tanger, and greetings from the secretary of the Society, Ph. Etter, the principal address was delivered by the president of the Society, P. Vischer, who outlined the history of engineering and architecture in Switzerland during the last hundred years. An exceptionally fine classical concert was followed by the greetings from foreign societies. A banquet and entertainment in the evening completed the day's events.

Sunday was given over to a most beautiful drive through the foothills east of Berne to Bad Gurnigel. A get-together meeting in the evening at the Casino finished the day and terminated the meeting proper.

Sight-Seeing and Inspection Trip for Guests

Monday and Tuesday were devoted to a sight-seeing and inspection trip for the delegates as guests of the Society. A short stop at Interlaken was rewarded with one of the most beautiful views in the Swiss Alps. A stop at Meiringen was followed by a walk through the celebrated gorge of the Vare to the Handegg Falls where the large hydroelectric plant of the Oberhasli Power Company is located. This plant has four Pelton-type wheels of 30,000 hp each, direct-connected to 28,000-kva, 11,000-volt, three-phase generators. Effective head at the nozzles is about 1600 ft. The power plant is entirely snowed in in winter and the employees and their families live in a large stone house connected to the powerhouse by a tunnel.

Because of frequent avalanches the current is conducted through cables in a three-mile long tunnel to the nearest village down the valley, Guttannen, where it is transformed from 50,000 to 150,000 volts for overhead transmission to connect with other networks covering the greater part of Western Europe. The tunnel is large enough to accommodate a small electric railroad which hauls supplies from Guttannen and in the winter takes the children to the village for school.

At the Grimsel Hospice

After inspecting the plant we proceeded to the Grimsel Hospice on the shore of the main reservoir for the power station. This lake, and a smaller one immediately above the power plant, store sufficient water to keep the plant running at full load continuously, although for seven months in the year they have to run with the water that is stored during the five months of the short summer season. The lake was formed by two dams, one a curved dam having a height of about 375 ft and the other one straight with a height of about 140 ft. The Hospice is built on a rocky hill between the two dams, being approached by a road running along the top of the straight dam.

At the Hospice an excellent lunch was served by the power company and then the trip continued over the Grimsel Pass to Gletsch in the upper Rhone Valley and up past the large Rhone Glacier over the Furka Pass to Goschenen at the mouth of the St. Gotthard tunnel. The stages were left at this point and the group proceeded by rail to Zurich in two of the new Swiss streamlined cars, the "Red Arrows."

At Zurich a sumptuous dinner was awaiting the visitors at the railroad station as guests of the Federal Railroads.

Tuesday, September 7 was spent inspecting the Federal Technical High School, or Polytechnicum, one of the leading engineering schools in Europe. The new electric, hydraulic, and mechanical laboratories were wonderfully equipped with the most up-to-date apparatus and machinery. After lunch several industrial works were visited. Your delegate chose to see the works of Sulzer Bros. at Winterthur, 15 miles from Zurich. These works, employing some 5000 men, are renowned for their centrifugal pumps and Diesel motors. Their large boiler shop turns out high-grade electric-welded pressure vessels of all kinds. It is said that 80 per cent of their production is exported.

Banquet Ends Celebration

The banquet in the evening at the principal hotel in Zurich ended the celebrations. During the meal speeches of thanks were given by different delegates. E. Bruce Ball, vice-president of the Institute of Mechanical Engineers, spoke for the English-speaking societies. In all nine speeches were made tendering the thanks from the thirty odd societies represented.

The whole meeting was wonderfully organized and went along without an apparent hitch of any kind. The treatment of the foreign delegates could not have been more considerate or generous. The hospitality of the Swiss Society of Engineers and Architects will never be forgotten by their guests.

FRANK A. LOCKWOOD.

Wisconsin's Home-Study Course in Technical Writing

TO INCREASE proficiency of technical men in writing business letters, reports, and articles for publication, The University of Wisconsin, Madison, Wis., is offering, through its extension division, a correspondence-study course in composition of technical papers. This course, which is available to individuals anywhere without interrupting their daily occupation, covers essential principles of English composition, planning and arrangement of technical papers, and other phases of clear and effective writing in a specialized field including important points in paragraphing, punctuation, capitalization, abbreviation, and proofreading. Ample practice in expositive writing on topics relating to a technical man's daily work is provided, thus affording an opportunity for immediate application of the training that he has received to his professional needs.

The Members' Page

A Forum for Frank Discussion by A.S.M.E. Members

More About Mechanical-Engineering Education[1]

The Members' Page:

At a recent organization meeting of the local Junior Group which was attended by those Junior Members who have shown the most interest in the movement and by two Senior Members, representatives from the executive committee of the Local Section, this question of establishing courses of instruction on specialized subjects in the field of mechanical engineering, was discussed. Without exception, every person present emphatically expressed a desire to avoid any meeting that had a classroom atmosphere. Formal, theoretical, or textbook meetings were voted down, while the more common, nontechnical engineering lectures and plant visits were emphatically accepted.

I have reached the general conclusion that only a clever lecturer would be able to include much formal or theoretical knowledge in his talk and still hold the interest of a large majority of the engineers usually found attending the meetings of Local Sections. Most of the Junior and a majority of the Senior Members as well, have not forgotten the generally uninteresting, formal, theoretical lectures of the college classroom where many seemingly nonessential facts were often forced into one's brain with much labor on the part of both instructor and student, only to be forgotten for lack of use after the examination. As for printing formal theoretical lectures, let me ask, how many members, Junior and Senior, read the A.S.M.E. Transactions which we receive every month? I know that a wealth of knowledge is stored in them, but still I seldom read more than a résumé of an article and, if I think it has a possibility of future use, I place another card in my index. In many cases not even this is done. Is it lack of interest, knowledge, or time?

Personally, I appreciate the potential value of formal, theoretical engineering knowledge, and I know a few engineers who would actively show their appreciation of an opportunity to increase their knowledge and value by attending such lectures or by taking such courses as Professor Eidmann[1] suggests and even paying a reasonable fee for that privilege. I suggest that those members, with a common interest, in any Local Section who desire this opportunity be encouraged to get together and study under one of their number as a leader. Let the Section that has one of the largest active memberships in this subject be the source of the printed matter which would be sent to those Local Sections having a smaller membership. In this way, lecturers would not have to repeat their talks many times. They would be able to produce more and better material, and the expense involved would be reduced considerably.

I believe that under no conditions should these formal, theoretical lectures and courses be substituted for, or otherwise represented at, regular meetings of the Local Sections where they are held.

Arnold H. Beede.[2]

The Members' Page:

A challenge has been made by a number of leaders of the industries, whom we would serve, that our college and university curricula are packed with technical courses to the exclusion of the humanities and other studies that make for better leadership. On the other hand, two years ago at an A.S.M.E. banquet table in Cincinnati the manager of a large Midwest Utility turned to me and wanted to know "why in the devil college graduates did not learn to throw a switch?" Should a minimum of technical training be included for the bachelor's degree to be supplemented later with short training courses or should the technical work be given to the extent that a student was able to "throw a few switches" while equipment was available to practice on, and then get his humanities by a good reading course supplemented by rubbing shoulders with other people in church organizations, service clubs, and civic betterment programs?

This might seem a matter for the Mechanical Engineering Division of the Society for the Promotion of Engineering Education, of which Professor Eidmann is chairman, but when you consider the fact that this group is made up almost entirely of educators you can see the importance of an A.S.M.E. Committee on Education, its membership to include practicing engineers and industrialists as well as educators.

The Engineers' Council for Professional Development has also challenged our Society to take care of professional training after graduation and student selection and guidance before starting in college. Here definitely we have been given a worthwhile job. What better start could we make than having our proposed Committee on Education study and plan for this work?

We cannot delay action longer, numerous agencies are working on the broad side of these problems but there seems a clear call to arms for a committee of mechanical engineers to get down to brass tacks in our chosen field and consider specific plans for better mechanical-engineering education, and I heartily second Professor Eidmann's proposal that the Council appoint such a committee at its next meeting.

Frank F. Groseclose.[3]

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[1] "Mechanical-Engineering Education," letter from F. L. Eidmann, Mechanical Engineering, vol. 59, June, 1937, p. 471.

[2] Engineer, Research Department, Dictaphone Corporation, Bridgeport, Conn. Chairman of Junior Group, A.S.M.E. Bridgeport Local Section.

[3] Associate Professor of Mechanical Engineering, University of North Carolina, Chapel Hill, N. C. Mem. A.S.M.E.

Junior Group Activities

Talk on "Sell America" Opens Season for the Philadelphia Juniors

THE JUNIOR Group of the Philadelphia Section, headed by John Barron, opened the fall season on October 11 with a talk by Mr. Disston of the H. L. Gilmer Company. The subject of Mr. Disston's talk was "Sell America." By very ably quoting statistics Mr. Disston showed how high the standard of living is in America. This he attributed to the great resourcefulness of the American people.

Another interesting point made was the place of the junior engineer in industry, a go-between for labor and industry. With his training he is in a position to see both sides of a controversy and be of real service.

On October 17 the Junior Group made an inspection trip through the Philadelphia Gas Works. Inclement weather made getting around difficult so a discussion of the making of gas was held indoors. The plant-inspection trip was exceptionally interesting.

Metro Juniors Show Active Interest in Seminars

National Defense, Air Conditioning, and Aeronautics

METROPOLITAN Juniors continue to show increasing interest in the programs of the Junior seminars inaugurated this year as successors to the old study groups. The most active seminars during the first two months of the fall schedule were those dealing with national defense, air conditioning, and aeronautics. Others on which organization work has been in process are planned to deal with general engineering, and economics from the engineers' point of view.

The general program is in charge of S. Shoor. The chairmen of the individual seminars are Michael Fexas, S. Davidson, and R. M. Frank, respectively of national defense, air conditioning, and aeronautics.

The problems of air conditioning have been features of October and November meetings of the Metropolitan Junior Group. At an air-conditioning seminar formed at a meeting held Wednesday evening, October 13, at the Engineering Societies Building, in New York, the attendance and enthusiasm shown encouraged the organization to sponsor the November general meeting of the Group. Mr. E. V. Erickson, manager of the New York Export Office of the Carrier Engineering Corporation, was invited to speak on the subject, "What the Air-Conditioning Industry Expects of the Engineer."

The air-conditioning seminar's organization meeting featured an informal talk by O. B. Schier, 2nd, of the Consolidated Edison Company, N. Y. Mr. Schier's "Introductory Remarks and Discussion" treated fundamental considerations in the air-conditioning field and served to present subject matter for a number of future meetings, each of which will deal with a specific problem.

The national-defense seminar of the Junior Group continues its activity. The most energetic and best supported of the former study groups, the organization counts among its members a large number of reserve officers, and cooperates with young engineers seeking to obtain commissions.

At the November 10 meeting Col. A. Gibson, Chemical Warfare Service, U. S. Army, was the invited speaker on the subject "Modern Developments in Chemical Warfare and Their Probable Effect on Future Wars."

Baltimore Juniors Plan Fine Schedule

THE JUNIOR Group of the A.S.M.E. Baltimore Section will hold its second meeting of the current season on November 23, 1937. At this meeting, to be held at the Johns Hopkins University, S. B. Sexton, 3rd, of the Safe Harbor Water Power Corporation, will present a paper on "The Development of Water Power"—a brief history of water power and a nontechnical description of present-day hydrostations and the equipment which is involved.

The Group hopes to make several inspection trips to local plants in the vicinity of Baltimore, among which are, The American Smelting and Refining Company, and the Rustless Iron Corporation of America.

In addition, a monthly program is planned by which the Group will be informed beforehand of meetings and scientific exhibitions sponsored by societies other than the A.S.M.E. in an attempt to make available a wider range of information.

Hempstead and Paine Talk to the Chicago Juniors on Engineering Valuation

JUNIOR engineers of the Chicago Section presented their November program before a packed house on November 8 when Prof. J. C. Hempstead, assisted by Prof. F. V. Paine, talked on "Engineering Valuation."

Selection of this topic and speakers was most timely since it coincided with the annual visit to Chicago of senior engineering students of Iowa State College. Professors Hempstead and Paine are associated with the general engineering department at Iowa State and have done considerable valuation work under Professor Marston who is a recognized national authority on this subject.

To promote a better understanding in engineering valuation the speaker showed how valuation principles developed from valuation litigation. He cited the Smyth vs. Ames case and quoted from the decision handed down by Justice Harlan in 1898. In this decision the court said ". . . to ascertain that value (fair value), the original cost of construction, the amount expended in permanent improvement, the amount and market value of the bonds and stock, the present as compared with the original cost of construction, the probable earning capacity of the property under particular rates prescribed by statute, and the sum required to meet operating expenses, are all matters for consideration, and are to be given such weight as may be just and right in each case."

This was followed with other historical cases and included the long-fought Illinois Bell Telephone case in which the court ruled that true depreciation charges must be used in establishing a fair value of their property.

Professor Hempstead outlined the process of making an appraisal and defined the terms: Present fair cost value, earning value, service worth, and stock and bond value. He also discussed depreciation methods and explained the operation of condition per cent tables.

Questions followed the discussion and by their nature showed the intense interest of those in attendance in this particular subject. A generous round of applause was extended at the conclusion of the meeting.

Junior engineers' activities in Chicago are under the direction of a Junior Executive Committee composed of cochairmen H. M. Black and A. H. Jens and Junior Members E. R. Rowley, R. M. Krause, and C. T. Link, Jr. Three of these men, Black, Jens, and Rowley, are members of the Chicago Section Executive Committee and represent Junior interests at committee meetings. Link is editor of the Chicago Section monthly bulletin and is ably assisted by Robert Hella.

Student Members Urged to Attend Junior Meetings

ONE OF the problems encountered by various Junior Groups is that of encouraging student members to attend Junior meetings for it is felt that a mutual advantage is lost by the failure of undergraduates to take part in such functions.

Several groups have assigned individual juniors to go back to college engineering-societies' meetings to urge there that they take full advantage of the privileges of Student Membership. The Metropolitan Junior Group tackles the problem in various ways. It invites student officers to attend an annual dinner to talk over the problem with them and has a number of cooperating committees, each of which is contributing its efforts toward the end that students may take an active part in Junior affairs, thus making easier their transfer both of interest and membership a little later.

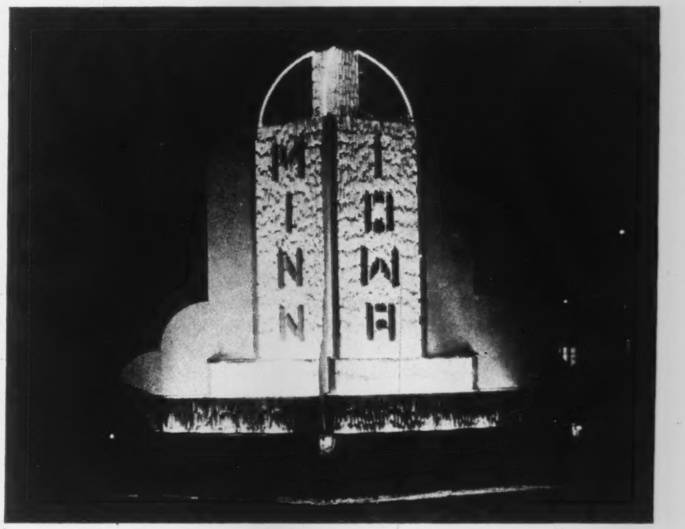
With the Student Branches

Officers and Committees

From the reports received in the last few weeks, we have compiled the following list of names of officers who have not been mentioned so far this term: Ohio Northern, Edward Prokop, Standly Strayer, Earl Salo, and Paul Adam. . . . Minnesota, Allan Paine, Willard J. Dye, Edward Pierson, and Wallace A. Lien. . . . Johns Hopkins, Vernon S. Ivins, Charles L. Westendorf and David H. Fax. . . . State University of Iowa, R. W. Lartz, V. H. Jungjohann, and J. D. Howard. . . . Northeastern, C. T. Grant, R. Mahaffy, and Neal V. Humphrey. Committees perform a valuable function in a student branch by apportioning the administrative work of the officers and giving members an opportunity to do their share. Messrs. O'Mara, Becica, and Hausman are members of the important Publicity Committee at Newark College. . . . At Northwestern, Cliff Becher is chairman of the Program Committee, Leonard Munson is chairman of the Papers Committee, and Harry Storms is in charge of the Membership Committee. . . .Mr. Spiller was appointed publicity manager of the Florida Branch. . . . Brooklyn Poly Branch has a Refreshments Committee composed of Messrs. Eriksen, Ritterbusch, and Grantz. . . .On a suggestion from National Headquarters, Chairman Richard W. Leins of Louisville Branch appointed William H. Hood, Charles Garvey, and Bruce McKercher as a committee to study and make recommendations on by-laws for student branches. . . .Texas University Branch has one of the most active student groups in the country. Committees and their membership who have done so much to achieve this honor are: Program, L. T. Wright, C. L. Crockett, and S. S. Weintraub; Membership, H. G. Walcott, James Mayer, R. J. Lee, and Steven Evans; Social, Roy Rather, Aaron Cohen, and Arthur Weintraub; Publicity, E. S. Perkins, V. E. Burton, and Ralph Hashagen.

Interesting Papers by Members

With so many interesting papers presented by student members, your editor finds it an impossibility to give you any summary whatsoever of all these talks. However, we will print the titles and names of authors as supplied to us by your corresponding secretaries. . . . Louisville Branch members heard Robert Weigel speak on "The Status of the Airplane Carrier" and Earl Ogden lecture on Diesel engines. . . . At Ohio Northern, Robert Reich spoke on lubrication and Robert Roth explained a method of heating brooder houses for ducks. . . . Bernard Yoshitani gave a talk on monorail conveyor systems before the U. S. C. Branch. At another meeting of this branch, Elmer Solomonson explained the operation of the Sperry Gyropilot, illustrating his paper with chalk diagrams on the blackboard. . . . The lenses for the new astronomical telescope at Chattanooga were ground by A. R. Jones and his father. He explained the process to his fellow members at the Tennessee Branch in a lecture illustrated with motion pictures. . . . Down at Texas Branch, H. G. Walcott told of "The Maintenance of Orientation in the Drilling of Deep Oil Wells" and M. Halpenny described a study of "Salt Water Encroachment in Texas Oil Fields". . . . N. Y. U. Branch (evening) members listened to a lecture on time and motion study illustrated with motion pictures given by M. J. Berg. . . .Texas Tech had Foster Garland talk on the relationship of airplane model building to the aircraft industry and L. J. Powers speak on the use of seismic recordings for oil-prospecting purposes. . . . Members of Pratt Branch listened to papers presented by Messrs. Woodger, Webb, and Scott on the National Metals Convention and Exposition held at Atlantic City which was attended by them. . . . West Virginia Branch members heard the following talks: "Magic Metal" by C. R. Iroms, "Plant Housekeeping" by H. A. Loria, "Gauley Bridge Power Development" by Mr. Buckley, "Propeller-Single Blade" by Mr. Balch, "Touring America in Fifty Minutes" by J. A. Towsend, "Mass Production of Light Airplanes" by K. E. Pyle, "Measuring Heat Engine Efficiency" by J. M. Bland, and "Controlling the Yellow River" by D. E. Hornbeck. . . . Several members told of their experiences on jobs during the summer at a meeting of Iowa State College Branch. Hubert Bierman told of his work with Ingersoll-Rand, T. K. Peterson was with the Viking Pump Co., Floyd Selim worked at the C. A. Dunham Mfg. Co., and James H. Boyd was at the River Rouge plant of the Ford Motor Company. . . . Papers presented at Michigan State College were "The Manufacture of the New Buick Self-Shifting Transmission" by John Austin, "Liquid Air Speeds up Assembly of Ford Valve Seat Inserts" by Paul Koopman, "Machine Design Developments in Soviet Russia" by Clifton Hand, "The Development of Heating of Refrigerator Cars" by D. B. Eames, and "Air Conditioning Influences on Building Design" by George Drake. . . . The following student talks were given at the Yale Branch: "Mercury Vapor Turbine Systems" by R. T. Reeder, "The Aerodynamics of Sales" by P. O'Gorman, "The World's Fair of 1939" by G. M. Neumunz, and "The Lynn Works of General Electric" by J. E. Murphy. . . . Additional talks were given at Michigan State College on the riveting of duralumin by Robert S. Trembath, on electric motors for air conditioning by Joseph E. Brundage, on "A Correlated Abstract on Superlattices" by R. Yohpe, on Diesel transportation by Lodo Habrle, and on Diesel-electric power for railroads by Millard Smith. . . . At another meeting at Yale, T. Wilson talked on photoelasticity, B. M. Shepard told of a spark plug for measuring cylinder-head temperatures, E. H. Scott discussed automatic gun mechanisms and R.



Corn Monument for Homecoming Erected by Engineering Students at the University of Iowa, Iowa City, Ia.

(The erection of a corn monument as a part of the homecoming decorations is an annual affair. Although it is a project of the engineering college, the members of the Student Branch of the A.S.M.E. played an important part in the design and building of the structure this year. Leonard Yuska, member of the Branch was chairman of the committee, and Vernon Jungjohann, another member, designed this year's monument.

The corn monument stands at the main entrance to the campus, is 20 ft high, and 60 bushels of corn were required to cover it.—Russell W. Lortz, chairman, A.S.M.E. Student Branch at the University of Iowa.)

Roseman spoke on die castings. . . . Joseph Brown and Ellis Smith of Nebraska spoke on the transmission of natural gas and flaws in castings, respectively. . . . Fred T. Gear, chairman of the Vermont Branch, gave a résumé of his experiences while working for the Jones & Lamson Co. during the summer. . . . And once again we hear about talks given by members of West Virginia. This time J. B. Anderson described safety devices on steam engines, W. J. Brown told of the prevention of occupational diseases, M. G. Clower explained the history of Canada's railway system, and W. H. Hudelson talked about fatigue tests.

Deans Address Branches

The advantages of joining the school's A.S.M.E. Student Branch were presented by the deans of the following schools at the initial branch meetings: Yale members heard Dean S. W. Dudley, Purdue listened to Dean A. A. Potter, Southern Methodist Branch had Dean Flatli, and Michigan welcomed Dean H. C. Anderson by having over 275 present at the meeting, Texas had Dean W. R. Woolrich. . . . Dana F. Lee of the National Advisory Committee on Aeronautics gave a lecture on "Fuel Injection Research" to the members of the Cornell Branch. . . . Dr. E. S. Lee of the General Electric Laboratories described micromeasurement by electrical means before the Stevens Branch. . . . Rensselaer Poly Branch members were privileged to listen to Harry R. Westcott tell about the problems and responsibilities of the consulting engineer. . . . Michigan State College had F. Steinhilber, director of personnel for the Lansing Division of the Fisher Body Corporation, describe the things for which an employer looks upon hiring an engineer. . . . Down South at the University of North Carolina, members heard and saw a sound motion picture on "Heat and Its Control" presented by Messrs. Whithurst and Leslie of the Johns-Manville organization. . . . Northwestern had Mr. Reidy of the Bethlehem Steel Company present a talk on "Wire" . . . . C. E. Davies, secretary of the A.S.M.E., was a guest at a luncheon held in his honor by the Kansas Branch. . . . Prof. R. C. Carpenter gave an excellent talk on the qualifications of an engineer before the Mississippi State Branch. . . . California Tech learned about steel fabrication from Mr. Gehert of Consolidated Steel. . . . Maxwell C. Maxwell, the well-known speaker of the Yale and Towne Co., spoke at a meeting of the Washington Branch and also at meetings of the California and Idaho Branches on locks. . . . Another steel man, J. D. Gordon of the Taylor-Winfield Corporation, talked about steel fabrication before a large assemblage at Purdue. Previous to the talk, mimeographed sheets describing his topic were passed out on the campus. . . . Continuing a custom originated some years ago, the Yale Branch inaugurated its new series of monthly talks on subjects outside of engineering by having Dr. H. S. Burr, a professor in the School of Medicine, describe the "impact of environment on the individual". . . . Michigan had E. J. Abbott, a physics research expert, present a talk on "Machinery Noise Reduction". . . . N. Y. U. (aeronautic division) had E. B. Schaefer give a short talk on lighter-than-air ships. . . . N. Y. U. (aeronautical and mechanical divisions) were fortunate to have Roy V. Wright, past president of the A.S.M.E. and managing editor of *Railway Age* speak on "Good Citizenship and the Engineer". . . . C. C. Franck of the Westinghouse Elec. & Mfg. Co. described "Modern Steam Turbines" to the members of the Lehigh Branch. . . . Six sound films were presented before the Texas Branch by J. L. McElyea of the Chevrolet Motor Company. . . . Newark Branch members listened to a talk about the U. S. Navy given by Howard E. Purdy, a graduate of Annapolis and an instructor at Newark College. . . . Fuel-injection systems for Diesel engines were described to the members of the Armour Branch by Frederick Behreus of the American Bosch Corporation. . . . An extemporaneous talk on aviation trends was given before the California Branch by W. F. McGinty of the Boeing School of Aeronautics. . . . Southern Methodist members learned about the many advantages to be gained in joining the A.S.M.E. from A. B. Pearson, chairman of the North Texas Section of the A.S.M.E.

Student Member Wins Oil World Exposition Prize

H. G. Walcott, a student member of the University of Texas Branch, was awarded a fourth prize of $25 for his paper on "The Importance and Methods of Maintaining Orientation in the Drilling of Deep Oil Wells" which was presented at the student prize paper competition of the Oil World Exposition held in Houston, Texas, from October 11 to 16. Mr. Walcott had presented this paper previously at one of the Branch meetings.

Branch Meetings

John Vye, chairman of the Northwestern Branch, has urged each member to prepare and present a fifteen-minute paper at one of the meetings held every Wednesday afternoon. . . . A film, "The Mechanics of Vibration," produced in the machine design laboratory of the mechanical engineering department of the University of Minnesota, was shown at a meeting of the Minnesota Branch. This was followed by the usual doughnuts and cider. . . . Newark Branch has planned a program for the coming year in which the following topics will be covered: air conditioning, aviation, metallurgy, steam power, conveying machines, automotive development, and precision measurement. . . . Texas Branch held a joint meeting on October 4th in conjunction with the student branches of the A.I.E.E., A.S.C.E., and the A.I.M.E. at which motion pictures were presented. . . . The Program Committee of the Wisconsin Branch has promised the members a year of meetings covering both professional and nonprofessional subjects. . . . Cornell Branch in a joint meeting with the A.S.M.E. local section and the student branches and local sections of the A.I.E.E. and A.S.C.E. listened to a very interesting talk on the handling of the dirt and gravel at the Grand Coulee Dam given by Gordon Dodge, a member of the A.S.M.E. . . . Case saw the film entitled "Steam" loaned to the organization by the Babcock & Wilcox Company. . . . Arden Scroggs, chairman of the Washington Branch, promised the members a year of interesting meetings and inspection trips. . . . M.I.T. Branch reports a meeting in the form of an informal smoker at which the usual doughnuts and cider were served after listening to Professor Fales describe the 1938 automobiles. . . . Kansas plans a joint meeting with the student branches of the A.I.E.E. and the Kansas State A.S.M.E. and A.I.E.E. . . . Michigan Tech enrolled twenty-four new members at the first meeting.

Inspection Trips

Vermont Branch members visited the Ed Lund factory where many different types of can openers, bottle openers, and egg beaters are manufactured. The stamping presses proved to be of most interest to the boys. . . . Stevens visited the Colgate-Palmolive-Peet Co. in Jersey City where the members saw the entire process of soap manufacture and a new 450-lb per sq in. boiler in the powerhouse. . . . Twenty-five members of Michigan State Branch visited the proving grounds of General Motors at Milford, Michigan. The inspection was climaxed with a ninety-miles-per-hour ride for each one around the four-mile speedway.

This and That

Case Branch passed a resolution asking the school to set aside a room in the Mechanical Engineering Building to be used as an A.S.M.E. clubroom. . . . Carl Fuller, chairman of the Akron Branch, suggested to the members that two meetings be held each month. Each member will be asked to take complete charge of one meeting, arrange the program, etc. . . . Papers presented at the Ohio Northern Branch meetings by the members will be judged by a committee consisting of Bruce Campbell, Wilbur Shannon, Donald Hale, and John Richardson. Two prizes will be awarded by the committee at the end of the year to the two members who in their opinion had presented the best papers. . . . Iowa State College secretary, James H. Boyd, reports that each meeting is opened "by group singing under the leadership of Hubert Bierman. By way of rollcall, each member present introduces himself to the group." To end the meeting, an old "peace pipe" is passed and with this traditional custom the session is closed. . . . Our thanks to the following corresponding secretaries for their complete and well-written reports which helped your editor a great deal: Texas, R. E. Powers; U. S. C., Charles Walker; Louisville, George Ellsworth; Brooklyn Poly, Gordon Morrow; Florida, Ed E. Bisson; Armour, Calvin K. Nauman; Newark, Robert H. Frohboese; Michigan State College, Donald McSorley; Southern Methodist Marvin Monroe and, Iowa State, James H. Boyd. . . . Student branches are requested to send in photographs about their doings, especially group pictures which include all members of the branch. If satisfactory, these pictures will be reproduced on this page. Don't forget to send us the names of those in the photograph.

Other Engineering Activities

E.C.P.D. Accredits Undergraduate Engineering Curricula

THE Engineers' Council for Professional Development has as its expressed objective enhancement of the status of the engineering profession. To this end, the Council has inaugurated a program dealing with the selection, guidance, training, and recognition of the members of the profession. This program is being carried out under the direction of four operating committees. One of these, the Committee on Engineering Schools, is expected, as part of its broad purpose of assisting in the improvement of the status of engineering education, "to formulate criteria for colleges of engineering, which will insure to their graduates a sound educational background for practicing the engineering profession." One important aspect of the activities of this committee is the procedure for accrediting engineering curricula. This phase of its program is intended to offer a single accrediting for the duplicated and uncoordinated procedures that have been used in the past.

E.C.P.D. is merely authorized by its constituent organizations to publish a list of accredited engineering curricula for use as desired by those agencies that require such a list. It has no authority to impose any restrictions or standardizations upon engineering colleges nor does it desire to do so. On the contrary, it aims to preserve the independence of action of individual institutions and to promote the general advancement of engineering education thereby. Consideration of curricula with a view toward accrediting is done at the invitation of the institution.

Basis for Accrediting Engineering Colleges

Principles, in accordance with which accrediting is conducted, are embodied in the following statement:

(1) Purpose of accrediting shall be to identify those institutions that offer professional curricula in engineering worthy of recognition as such.

(2) Accrediting shall apply only to those curricula that lead to degrees.

(3) Both undergraduate and graduate curricula shall be accredited. (Accrediting program at present embraces undergraduate curricula only.)

(4) Curricula in each institution shall be accredited individually. For this purpose, E.C.P.D. will recognize the six major curricula; chemical, civil, electrical, mechanical, metallurgical, and mining engineering, which are represented in its own organization, and such other curricula as are warranted by the educational and industrial conditions pertaining to them.

(5) Curricula shall be accredited on the basis of both qualitative and quantitative criteria.

(6) Qualitative criteria shall be evaluated through visits of inspection by a committee or committees of qualified individuals representing the E.C.P.D.

(7) Quantitative criteria shall be evaluated through data secured from catalogs and other publications and from questionnaires.

(8) Qualitative criteria shall include the following:

(*a*) Qualifications, experience, intellectual interests, attainments, and professional productivity of members of the faculty

(*b*) Standards and quality of instruction in:

(1) Engineering departments

(2) Scientific and other cooperating departments in which engineering students receive instruction

(*c*) Scholastic work of students

(*d*) Records of graduates both in graduate study and in practice

(*e*) Attitude and policy of administration toward its engineering division and toward teaching, research, and scholarly production.

(9) Quantitative criteria shall include the following:

(*a*) Auspices, control and organization of the institution and of the engineering division

(*b*) Curricula offered and degrees conferred

(*c*) Age of the institution and of the individual curriculum

(*d*) Basis of and requirements for admission of students

(*e*) Number of students enrolled

(1) In the engineering college or division as a whole

(2) In the individual curriculum

(*f*) Graduation requirements

(*g*) Teaching staff and teaching loads

(*h*) Physical facilities: The educational plant devoted to engineering education

(*i*) Finances: Investments, expenditures, sources of income.

Information supplied by the questionnaire or otherwise is for the confidential use of the E.C.P.D. and its agents and will not be disclosed without the specific written authorization of the institution concerned.

Accrediting Procedure

An institution desiring accrediting of any or all of its undergraduate curricula that lead to a degree in engineering may communicate directly with the E.C.P.D. Committee on Engineering Schools. Arrangements will then be made for securing information by questionnaire and for an inspection of the educational facilities of the institution by a regional subcommittee.

Each committee of inspection is selected from the membership of the regional committee operating in the area in which the institution is located on the basis of the curricula to be considered. The visiting committee reports its findings to the regional committee, which after consideration of all available information, submits a set of tentative recommendations to the Committee on Engineering Schools. Final decision as to accrediting rests with the E.C.P.D. which passes on the recommendations made to it by the Committee on Engigineering Schools.

Recommendations as to curricula in chemical engineering are transmitted to the Committee on Engineering Schools by the Committee on Chemical Engineering Education of the American Institute of Chemical Engineers. All visits of inspection of curricula not previously accredited by the A.I.Ch.E. are made concurrently with the general inspections of other curricula and the committees function as a single unit in each region. Curricula in chemical engineering previously approved by the American Institute of Chemical Engineers have been accredited by E.C.P.D. upon the recommendation of the Committee on Engineering Schools.

Scope of Accredited List

This list includes only such undergraduate engineering curricula as have been judged by E.C.P.D. to be worthy of accrediting. It does not include certain specialized curricula submitted for consideration, which, though apparently outstanding in restricted fields, are not closely related to engineering as it is interpreted by E.C.P.D.

In some cases, accrediting has been made provisional for a limited period, from one to three years, with reappraisal stipulated at the end of the period. Provisional accrediting is based upon conditions that E.C.P.D. has not found to be entirely satisfactory but that may be quickly improved, or conditions that are now satisfactory but whose future appears precarious. Such conditions include the following: Uncertainty as to financial status; need for minor additions to staff or equipment; curriculum new or in state of transition; uncertainty due to nature of administrative organization; and unusual dependence upon strength of a single individual. Where provisional accrediting has been granted, the institution has indicated that an effort will be made to remedy the unsatisfactory condition within the stipulated period of provisional accrediting. The fact that accrediting may thus be provisional is, in each case, a confidential matter with E.C.P.D.

E.C.P.D. has yet under consideration curricula at five institutions which applied for accrediting with the request that the visits of inspection be made in 1937–1938. The present list, dating from Oct. 1, 1937, will again be subject to revision in the fall of 1938, as the list is to be revised annually. Through its Committee on Engineering Schools, E.C.P.D. will keep currently informed regarding significant changes in curricula, staff, facilities, organization, enrollment, and similar matters in institutions where curricula have been accredited and will arrange to have certain institutions revisited each year. Personnel of the accrediting committees for the coming year will remain nearly unchanged, as will also the accrediting procedure. Requests for further information relative to E.C.P.D. and the accrediting program should be addressed to A. B. Parsons, Secretary, Engineers' Council for Professional Development, 29 West 39th St., New York, N. Y.

List of Accredited Curricula

The E.C.P.D. has prepared two lists of the undergraduate engineering curricula accredited by it, one arranged by institutions and the other by curricula. The list of curricula arranged by institutions follows:

University of Alabama: Aeronautical, Civil, Electrical, Industrial, Mechanical, Mining.
University of Arizona: Civil, Electrical, Mechanical, Mining.
University of Arkansas: Civil, Electrical, Mechanical.
Armour Institute of Technology: Chemical, Civil, Electrical, Mechanical.
Brown University: Civil, Electrical, Mechanical.
Bucknell University: Civil, Electrical.
University of California: Civil, Electrical, Mechanical, Metallurgical, Mining, Petroleum.
California Institute of Technology: Aeronautical (Six-year course), Chemical (Five-year course), Civil, Electrical, Mechanical.
Carnegie Institute of Technology: Chemical, Civil (*a*), Electrical (*a*), Industrial (Management) (*a*), Mechanical (*a*), Metallurgical (*a*).
Case School of Applied Science: Chemical, Civil, Electrical, Mechanical, Metallurgical.
University of Cincinnati: Aeronautical, Chemical, Civil, Electrical, Mechanical.
The Citadel: Civil.
Clarkson College of Technology: Civil, Electrical, Mechanical.
Clemson Agricultural College: Civil, Electrical, Mechanical.
College of the City of New York: Civil (*a*), Electrical (*a*), Mechanical (*a*).
University of Colorado: Architectural, Civil, Electrical, Mechanical.
Colorado School of Mines: Geological, Metallurgical, Mining, Petroleum.
Columbia University: Chemical (*b*), Civil (*b*), Electrical (*b*), Industrial (*b*), Mechanical (*b*), Metallurgical (*b*), Mining.
Cooper Union Institute of Technology Civil (*c*), Electrical (*c*), Mechanical (*c*).
Cornell University: Chemical, Civil, Electrical, Industrial (Administrative), Mechanical.
Dartmouth College: Civil.
University of Delaware: Civil, Electrical, Mechanical.
University of Detroit: Aeronautical, Architectural, Civil, Electrical, Mechanical.
Drexel Institute: Chemical, Civil, Electrical, Mechanical.
Duke University: Civil, Electrical, Mechanical.
University of Florida: Civil, Electrical, Industrial, Mechanical.
Georgia School of Technology: Aeronautical, Civil (*d*), Electrical (*d*), Mechanical (*d*).
Harvard University: Civil (*e*), Communication (*e*), Electrical (*e*), Industrial (Engineering and Business Administration) (*e*), Mechanical (*e*), Metallurgical (Physical Metallurgy) (*e*), Sanitary (*e*).
Howard University: Civil, Electrical, Mechanical.
University of Idaho: Civil, Electrical, Mechanical.
University of Illinois: Architectural, Ceramic (Technical Option), Chemical, Civil, Electrical, General (*f*), Mechanical, Metallurgical, Mining.
Iowa State College: Argricultural (*g*), Architectural, Chemical, Civil, Electrical, General (*f*), Mechanical.
State University of Iowa: Chemical, Civil, Electrical, Mechanical.
Johns Hopkins University: Civil, Electrical, Mechanical.
University of Kansas: Architectural, Civil, Electrical, Mechanical, Mining.
Kansas State College: Agricultural (*g*), Architectural, Civil, Electrical, Mechanical.
University of Kentucky: Civil, Metallurgical, Mining.
Lafayette College: Civil, Electrical, Industrial (Administrative), Mechanical, Metallurgical, Mining.
Lehigh University: Chemical, Civil, Electrical, Industrial, Mechanical, Metallurgical Mining.
Louisiana State University: Civil, Electrical, Mechanical, Petroleum.
University of Louisville: Chemical, Civil, Electrical, Mechanical.
University of Maine: Civil, Electrical, General (*f*), Mechanical.
Marquette University: Civil, Electrical, Mechanical.
University of Maryland: Civil, Electrical, Mechanical.
Massachusetts Institute of Technology: Aeronautical, Architectural, Building and Construction, Chemical, Civil, Electrical, Electrochemical, General (*f*), Industrial (Business and Engineering Administration), Mechanical, Metallurgical (Metallurgy), Mining, Naval Architecture and Marine, Public Health, Sanitary.
University of Michigan: Aeronautical, Chemical, Civil, Electrical, Engineering Mechanics, Mechanical, Metallurgical, Naval Architecture and Marine, Transportation.
Michigan College of Mining and Technology: Civil, Electrical, Mechanical, Metallurgical, Mining.
Michigan State College: Civil, Electrical, Mechanical.
University of Minnesota: Aeronautical Chemical, Civil, Electrical, Mechanical, Metallurgical, Mining (excluding Mining in Geology option), Petroleum.
University of Missouri: Civil, Electrical, Mechanical.
Missouri School of Mines and Metallurgy: Ceramic, Civil, Electrical, Metallurgical, Mining (Mine) (excluding Mining in Geology option).
Montana School of Mines: Geological, Metallurgical, Mining.
Montana State College: Civil, Electrical, Mechanical.
University of Nebraska: Agricultural (*g*), Architectural, Civil, Electrical, Mechanical.
University of Nevada: Electrical, Mining.
University of New Hampshire: Civil, Electrical, Mechanical.
University of New Mexico: Civil, Electrical, Mechanical.
New York University: Aeronautical, Chemical (*h*), Civil (*a*), Electrical (*a*), Mechanical (*a*).
New York State College of Ceramics (At Alfred University): Ceramic.
Newark College of Engineering: Civil, Electrical, Mechanical.
North Carolina State College: Ceramic, Civil, Electrical, Mechanical.
University of North Dakota: Civil, Electrical, Mechanical, Mining.
Norwich University: Civil, Electrical.
Ohio State University: Ceramic, Chemical, Civil, Electrical, Industrial, Mechanical, Metallurgical, Mining (Mine).
University of Oklahoma: Architectural, Civil, Electrical, Mechanical, Petroleum (Production option).
Oklahoma A. & M. College: Civil, Electrical, Industrial, Mechanical.
Oregon State College: Civil (excluding Business option), Electrical (excluding Business option), Mechanical (excluding Business option).
University of Pennsylvania: Chemical, Civil, Electrical, Mechanical.
Pennsylvania State College: Architectural, Chemical, Civil, Electrical, Electrochemical, Industrial, Mechanical, Sanitary.
University of Pittsburgh: Chemical, Civil, Electrical, Industrial, Mechanical, Metallurgical, Mining, Petroleum, Petroleum Refining.
Polytechnic Institute of Brooklyn: Chemical (*h*), Civil (*a*), Electrical (*a*), Mechanical (*a*).
Princeton University: Chemical, Civil, Electrical, Mechanical.
Purdue University: Chemical, Civil, Electrical, Mechanical.
Rensselaer Polytechnic Institute: Chemical, Civil, Electrical, Mechanical.
Rhode Island State College: Civil, Electrical, Mechanical.
Rice Institute: Civil, Electrical, Mechanical.
University of Rochester: Mechanical.
Rose Polytechnic Institute: Civil, Electrical, Mechanical.
Rutgers University: Civil, Electrical, Mechanical, Sanitary.
University of Santa Clara: Civil, Electrical, Mechanical.
South Dakota State College: Civil, Electrical, Mechanical.
South Dakota State School of Mines: Civil, Electrical, Metallurgical, Mining.
University of Southern California: Petroleum.
Stanford University: Civil, Electrical, Mechanical, Metallurgical, Mining, Petroleum.
Stevens Institute of Technology: General (*f*).
Swarthmore College: Civil, Electrical, Mechanical.

SYRACUSE UNIVERSITY: Civil, Electrical, Industrial (Administrative), Mechanical.

UNIVERSITY OF TENNESSEE: Civil, Electrical, Mechanical.

UNIVERSITY OF TEXAS: Civil, Electrical, Mechanical, Petroleum (Petroleum Production).

A. & M. COLLEGE OF TEXAS: Civil, Electrical, Mechanical, Petroleum.

TEXAS TECHNOLOGICAL COLLEGE: Civil, Electrical, Mechanical.

TUFTS COLLEGE: Civil, Electrical, Mechanical.

TULANE UNIVERSITY OF LOUISIANA: Civil, Electrical, Mechanical.

UNION COLLEGE: Civil, Electrical.

UNIVERSITY OF UTAH: Civil, Electrical, Mechanical, Metallurgical, Mining.

UNIVERSITY OF VERMONT: Civil, Electrical, Mechanical.

UNIVERSITY OF VIRGINIA: Civil, Electrical, Mechanical.

VIRGINIA MILITARY INSTITUTE: Civil, Electrical.

VIRGINIA POLYTECHNIC INSTITUTE: Civil, Electrical, Industrial, Mechanical.

WASHINGTON UNIVERSITY: Architectural, Civil, Electrical, Industrial (Administrative), Mechanical.

UNIVERSITY OF WASHINGTON: Aeronautical, Ceramic, Chemical, Civil, Electrical, Mechanical, Metallurgical, Mining.

STATE COLLEGE OF WASHINGTON: Civil, Electrical (Basic and Hydroelectric options), Mechanical (Basic option), Metallurgical, Mining (excluding Mine Administration and Petroleum Engineering option).

WEBB INSTITUTE OF NAVAL ARCHITECTURE: Naval Architecture and Marine.

WEST VIRGINIA UNIVERSITY: Civil, Electrical, Mechanical, Mining.

UNIVERSITY OF WISCONSIN: Chemical, Civil, Electrical, Mechanical, Metallurgical, Mining.

WORCESTER POLYTECHNIC INSTITUTE: Civil, Electrical, Mechanical.

YALE UNIVERSITY: Chemical, Civil, Electrical, Mechanical, Metallurgical.

Explanatory Notes

(*a*) Accrediting applies to both day and evening curricula.

(*b*) Accrediting applies to four-year and five-year curricula leading to the Bachelor of Science degree.

(*c*) Accrediting applies to day curriculum only. Action on evening curriculum deferred pending granting of degrees.

(*d*) Accrediting applies to both regular and cooperative curricula.

(*e*) Accrediting applies only to curriculum as submitted to E.C.P.D. and upon completion of which a certificate is issued by Harvard University certifying that student has pursued such a curriculum.

(*f*) Accrediting of a curriculum in general engineering implies satisfactory training in engineering sciences and in basic subjects pertaining to several fields of engineering; it does not imply accrediting, as separate curricula, of those component portions of the curriculum such as civil, mechanical, or electrical engineering that are usually offered as complete professional curricula leading to degrees in these particular fields.

(*g*) All curricula in agricultural engineering which appear in this list have been provisionally accredited for a period of two years The reason for this is twofold: In the first place it appears to E.C.P.D. that the final year of the four-year programs fails to build, in adequate manner, upon the engineering basis laid in the first three years; secondly, it is the feeling of E.C.P.D. that curricula in agricultural engineering might more properly be given as options under one of the major engineering branches (i.e., civil, electrical, or mechanical engineering).

(*h*) E.C.P.D. has not received from its subcommittee on chemical engineering a recommendation with respect to the evening curriculum in chemical engineering.

N.C.S.B.E.E. Meets at Scranton and Elects Officers

THE Eighteenth Annual Convention of the National Council of State Boards of Engineering Examiners was held in Scranton, Pa., on Oct. 11 to 13, 1937, with President J. S. Dodds of Ames, Iowa, presiding. Twenty-eight of the 38 member boards were represented.

The report of the committee on uniform examinations revealed that of 33 states reporting, 29 conduct written examinations which average 14 hr; 25 states differentiate their examinations for the several branches of engineering; four have a common examination for all branches, and 16 hold an oral examination in addition to the written examination.

In a tabulation of violations of the registration laws the committee on legal procedure presented returns from 18 states showing 224 violations resulting in 94 agreements to discontinue practice, 45 applications for new or for reinstatement of former registration, and 10 convictions. Actions on the remainder of the cases are still pending or the complaints have been found to be unjustified, unfounded, or not fully sustained.

The N.C.S.B.E.E. approved the report of its committee on accrediting schools which proposed that the E.C.P.D. list of accredited undergraduate engineering curricula be recommended to the individual state boards for adoption.

Col. Willard T. Chevalier was the speaker at the dinner on Oct. 11, 1937, at which Col. C. E. Meyer acted as toastmaster.

The model law for registration, prepared in draft form by the committee of the American Society of Civil Engineers, was discussed and some modifications were suggested.

The report of the executive secretary, T. Keith Legaré, of Columbia, S. C., pointed out that the 39 boards represented in the National Council report a total of approximately 53,000 registered professional engineers and land surveyors. New license laws were passed during the preceding year by Georgia, Nebraska, and Texas. The boards in these states have now joined the National Council.

Officers for the new year are as follows: President, Samuel H. Graf, Corvallis, Ore., member A.S.M.E.; vice-president, Charles F. Scott, New Haven, Conn., member A.S.M.E.; directors, Northeast Zone, Col. C. E. Meyers, of Philadelphia; Central Zone, J. O. Kammermann, Rapid City, S. D.

The foregoing, with past-president J. S. Dodds and the secretary, T. Keith Legaré, of Columbia, S. C., and the two other directors, K. C. Wright, of Salt Lake City and C. L. Mann, of Raleigh, N. C., constitute the officers of the National Council.

Highway Research Board Expands Annual Meeting

Four-Day Session in Washington, D. C., Nov. 30 to Dec. 3, 1937

IN ORDER to provide opportunity for needed discussion of many important road and transportation problems, the seventeenth annual meeting of the Highway Research Board of the National Research Council is scheduled to be held in Washington, D. C. for four days commencing Tuesday, November 30 through December 3, instead of the two days that formerly were found sufficient. A large part of the time will be devoted to open departmental meetings on economics, design, materials and construction, soils investigations and roadside development.

Research work on all phases of highway transportation has been very active during the past year, and reports of widespread activities will be reported upon and discussed by men who are doing notable research work.

United Engineering Trustees Elect Officers

D. ROBERT YARNALL, fellow A.S.M.E., chief engineer of the Yarnall-Waring Company, Philadelphia, has been elected president of the United Engineering Trustees, Inc., joint agency of the four Founder Engineering Societies. Henry A. Lardner, member A.S.M.E., vice-president of the J. G. White Engineering Corporation, New York, and Albert Roberts, secretary of the Minerals Separation North America Corporation, New York, who was reelected treasurer last year, were elected vice-presidents. John H. R. Arms, member A.S.M.E., general manager of the United Engineering Trustees, Inc., continues as secretary. H. R. Woodrow, vice-president of the Consolidated Edison Company of New York, was promoted from assistant treasurer to succeed Mr. Roberts and, in turn, is succeeded by J. P. H. Perry, vice-president of the Turner Construction Company, New York.

Trustees elected by the Founder Societies were Kenneth H. Condit, manager A.S.M.E., editor of *American Machinist;* Frank M. Farmer, member A.S.M.E., vice-president and chief engineer of the Electrical Testing Laboratories; Otis E. Hovey, member A.S.M.E., consulting engineer, and vice-president of the United Engineering Trustees, Inc., last year; and W. D. B. Motter, Jr., assistant to the vice-president of the Chile Exploration Company. Other trustees are John P. Hogan, member A.S.M.E., chief engineer of the New York World's Fair of 1939; H. P. Charlesworth, assistant chief engineer of the American Telephone & Telegraph Co.; and A. L. J. Queneau, metallurgist of the United States Steel Corporation.

Library Board Elects New Officers

AT THE annual meeting of the Library Board of the United Engineering Trustees held on October 14, 1937, the following appointments to the Board were announced, and officers elected:

Sydney H. Ball reappointed by the Board of Trustees of United Engineering Trustees, Inc.

J. K. Finch appointed by the American Society of Civil Engineers

W. I. Slichter reappointed by the American Institute of Electrical Engineers

John Blizzard appointed by The American Society of Mechanical Engineers

F. F. Sharpless reappointed by the American Institute of Mining and Metallurgical Engineers

Thomas T. Read appointed by the American Institute of Mining and Metallurgical Engineers to take the place of H. K. Masters, resigned

As officers of the Board, Charles E. Trout was elected chairman, A. R. Mumford, Mem. A.S.M.E., vice-chairman, and W. S. Barstow, A. W. Berresford, Albert Roberts, and J. J. Yates, were elected members of the executive committee.

Engineering Foundation Officers for 1937–1938

ALL of the recently elected officers of The Engineering Foundation are members of A.S.M.E. The chairman, F. M. Farmer, vice-president and chief engineer of the Electrical Testing Laboratories, New York, N. Y., and the vice-chairman, D. Robert Yarnall, chief engineer of the Yarnall-Waring Company, Philadelphia, Pa., were both reelected. The duties of the director and secretary, which were performed by the late Alfred D. Flinn, have been divided between Otis E. Hovey, consulting engineer, New York, N. Y., who was chosen as director, and John H. R. Arms, secretary and general manager of the United Engineering Trustees, Inc., who was elected secretary.

Mr. Yarnall was also elected chairman of the Executive and Research Procedure Committees. In addition to Chairman Yarnall and Mr. Farmer, who as chairman of the Foundation is an ex-officio member, the personnel of the Executive Committee is George E. Beggs, professor of civil engineering, Princeton University; A. L. J. Queneau, metallurgist, United States Steel Corporation, New York, N. Y.; and W. I. Slichter, member A.S.M.E., professor of electrical engineering, Columbia University.

Research Procedure

The Research Procedure Committee members are F. F. Colcord, vice-president, United States Smelting Lead Refinery, Inc., New York, N. Y., representing the Foundation; Fred O. Scobey, United States Department of Agriculture, Berkeley, Calif., representing the American Society of Civil Engineers; Sam Tour, vice-president, Lucius Pitkin, Inc., New York, N. Y., representing the American Institute of Mining and Metallurgical Engineers, Inc.; W. H. Fulweiler, Wallingford, Pa., representing The American Society of Mechanical Engineers; L. W. Chubb, director, Westinghouse Research Laboratories, East Pittsburgh, Pa., representing the American Institute of Electrical Engineers; and Mr. Farmer, ex-officio. With the exception of Messrs. Colcord and Scobey, all of this committee, including Chairman Yarnall, were reelected.

Iron Alloys

George B. Waterhouse, Massachusetts Institute of Technology, was reelected chairman of the Iron Alloys Committee and will again be assisted by the following members: James H. Critchett, vice-president, Union Carbide & Carbon Laboratories, Inc., New York, N. Y.; R. S. Dean, chief engineer of the metallurgical division, United States Bureau of Mines, Washington, D. C., representing John W. Finch, director of the Bureau; John Johnston, director of research, United States Steel Corporation, Kearney, N. J.; James T. MacKenzie, metallurgist and chief chemist, American Cast Iron Pipe Company, Birmingham, Ala.; Bradley Stoughton, dean, Lehigh University, Bethlehem, Pa.; Jerome Strauss, vice-president, Vanadium Corporation of America, Bridgeville, Pa.; Wilfred Sykes, assistant to the president, Inland Steel Company, Chicago, Ill.; J. G. Thompson, chief of the section on chemical metallurgy, National Bureau of Standards, Washington, D. C., representing Lyman J. Briggs, director of the Bureau; and T. H. Wickenden, member A.S.M.E., metallurgical engineer, International Nickel Company, New York, N. Y.; with Frank T. Sisco, New York, N. Y., as editor.

Welding Research

The personnel of the Welding Research Committee is as follows: Comfort A. Adams, member A.S.M.E., consulting engineer, Edward G. Budd Manufacturing Co., Philadelphia, Pa., chairman; Everett Chapman, member A.S.M.E., president, Lukenweld, Inc., Coatesville, Pa.; J. H. Critchett, vice-president, Union Carbide & Carbon Research Laboratories, Inc., New York, N. Y.; J. J. Crowe, Air Reduction Company, Jersey City, N. J.; Arthur S. Douglass, construction engineer, The Detroit Edison Company; C. L. Eksergian, member A.S.M.E.; chief engineer, Budd Wheel Company, Detroit, Mich.; A. J. Ely, member A.S.M.E., mechanical engineer, Standard Oil Development Company, Elizabeth, N. J.; Henry M. Hobart, member A.S.M.E., consulting engineer, General Electric Company, Schenectady, N. Y.; D. S. Jacobus, past-president, A.S.M.E., advisory engineer, Babcock & Wilcox Company, New York, N. Y.; Col. G. F. Jenks, member A.S.M.E., Ordnance Department, U. S. A., Washington, D. C.; Jonathan Jones, chief engineer of fabricated-steel construction, Bethlehem Steel Company, Bethlehem, Pa.; P. G. Lang, Jr., engineer of bridges, Baltimore & Ohio Railroad, Baltimore, Md.; F. T. Llewellyn, research engineer, United States Steel Corporation, New York, N. Y.; and Aubrey Weymouth, vice-president and chief engineer, Post & McCord, Inc., New York, N. Y., alternate for Mr. Jones; with William Spraragen, technical secretary and editor, American Welding Society, New York, N. Y., as secretary.

Barodynamic Research

Howard N. Eavenson, mining engineer, Pittsburgh, Pa.; John W. Finch, director, United States Bureau of Mines, Washington, D. C.; and Herbert G. Moulton, consulting mining engineer, New York, N. Y., comprise the Foundation's Advisory Committee on Barodynamic Research.

Consumers' Counsel, N.B.C.C. Proposes Uniform Description of Coal

Plans to Call Consumers' Conference

RECOMMENDATIONS to the National Bituminous Coal Commission for adoption of a nontechnical uniform description of bituminous coals to protect consumers from misrepresentation and enable them to know exactly what type of coal they are buying, have been made public by Consumers' Counsel, John Carson.

Carson's recommendations, on which the commission has as yet taken no action, were made under authority given him by the Bituminous Coal Act of 1937 which established his office to protect the interests of consumers. Details of his plan, subdivided into twelve proposals, are contained in a booklet "How Much Heat," published by the office of the Consumers' Counsel.

The plan would require bituminous producers to file with the commission uniform descriptive specifications of their coal within six months after the commission orders such action. Producers misrepresenting such specifications would be subject to the penalties set up in the Act for unfair trade practices. Uniform specifications, the Counsel suggested, should be furnished upon request.

No additional burden would be imposed upon operators by such a plan, the booklet points out, because the measurable factors necessary for uniform specifications would undoubtedly have to be furnished no matter what classification standards the commission ultimately adopts.

Carson also proposed that facilities be provided by the commission, at the request of any consumer, for checking its filed specifications against the rank and grade specifications forwarded to it. Action would then be instituted against a producer should variations in the two groups of specifications be pronounced.

Included in "How Much Heat" is the testimony given by a purchasing agent at the commission's hearing on classifications last July, that in the past a great deal of misrepresentation has been given to buyers, and not always unintentionally.

This booklet is the first of a series of "Consumer Ideas" published by the Consumers' Counsel to deal with practical problems of bituminous consumers.

Consumer's Conference to Be Held

The Consumers' Counsel is concerned to know whether consumers may be discriminated against in bituminous-coal prices and will call a conference to discuss it as soon as proposed prices are available. Producers of bituminous coal have met regularly for months in preparing minimum prices which are now being submitted to the National Bituminous Coal Commission for consideration at forthcoming hearings.

Consumers are entitled to be heard at these hearings, and with this in view, the Consumers' Counsel is calling this conference in Washington for consumers to learn of the proposed prices, to determine whether they are fair, and to decide upon proper action. All consumers interested in the proposed price schedules will be invited to attend.

It is expected that the Consumers' Conference will be held some time in December.

The conference will afford consumers an opportunity to present their views and learn what other consumers think. It will be the aim of the conference to map out a coherent program to follow in the presentation of consumer testimony at the commission's minimum-price hearings.

Testimony by consumer representatives at the commission's hearings will be particularly welcome. The Consumers' Counsel will arrange for their appearance so that loss of time will be minimized. Persons desiring to participate in the conference should communicate with John Carson, Consumers' Counsel, National Bituminous Coal Commission, United States Department of the Interior, Washington, D. C.

A Correction

IN THE November issue it was reported that H. P. Hammond, of Pennsylvania State College, was elected vice-chairman of E.C.P.D. This statement was not correct. The office of vice-chairman was not filled in the recent elections.

Program for Section M (Engineering) at A.A.A.S. Annual Meeting, Indianapolis, Dec. 27-31

Social Impacts of Science and Technology

ENGINEERS interested in the social impacts of science and technology will have an unusual opportunity to participate in a series of conferences on this timely subject at the annual meeting of the American Association for the Advancement of Science to be held in Indianapolis, Ind., the week of December 27, 1937.

Dr. Joseph W. Barker, dean, School of Engineering, Columbia University, vice-president of the Section on Engineering, announces that in cooperation with Dr. F. R. Moulton, permanent secretary of the American Association for the Advancement of Science, arrangements have been made for coordinating the stated meeting of the Section on Engineering with a series of conferences on science and society, of which Dr. Harold G. Moulton, president of the Brookings Institution of Washington, is general chairman.

Dr. Wickenden's Address

On Wednesday afternoon, December 29, at the stated meeting of Section M, Dr. William E. Wickenden, president of Case School of Applied Science, and retiring vice-president of Section M, will deliver an address on "The Social Sciences and Engineering Education." Later in the same afternoon there will be prepared discussions of "Power Resources" by Dr. A. A. Potter, dean of engineering, Purdue University, and past-president, A.S.M.E., and on "Capital Resources" by Dr. David Friday, economist.

At the first of the conferences on science and society on Monday afternoon, December 27, Dr. Harold G. Moulton will present his address "Controlled Factors in Economic Development." On Tuesday the subject will be natural resources, to be covered by C. K. Leith on "Mineral Resources" and by a speaker yet to be announced on "Agricultural and Forest Resources."

Thursday's topic "Human Resources" will be divided into "Man Power," an address to be delivered by Frederick Osborn, and "The Utilization of Human Resources" by Edward C. Lindeman.

"The Application of Science to Business" will be covered in two papers to be given on Friday, December 31, the first by Dr. H. S. Person on "Scientific Methods of Business Organization," and the second on "Research Laboratories in the Spirit of Science."

Sigma Xi Lecture by Dr. Langmuir

The Sigma Xi Lecture will be delivered on Tuesday evening, December 28, by Dr. Irving Langmuir, whose subject is "The Physiological Significance of Mono-Molecular Films."

By invitation of the officers of Section M, sponsoring host for the meetings is the Indiana Engineering Council, representing the organized engineering group of Indiana, including the local sections of the national engineering societies. Arrangements for attendance are in charge of a committee of the Indiana Engineering Council consisting of M. R. Keefe, president, Homer Rupard (Mem. A.S.M.E.), secretary, and William A. Hanley, past vice-president, A.S.M.E.

American Engineering Council

The News From Washington

Accurate Maps and Public Works

IN RESPONSE to an invitation from the Federal Board of Surveys and Maps, the American Engineering Council through its Surveys and Maps Committee composed of Dodds of Iowa, Bowie of the District of Columbia, Branner of Arkansas, Sumwalt of South Carolina, and Trullinger of Washington, D. C., has prepared a statement to be used by a special committee in an effort to have the "Mapping Agencies" seek additional appropriations from Congress for the acceleration of "basic mapping" under the Temple Act during the fiscal year ending June 30, 1939. A portion of the statement follows.

"American Engineering Council has for many years vigorously supported, in the public interest, the requests of our member engineering organizations that the basic map of the United States be completed at the earliest possible date. As a move in the right direction, the American Engineering Council has accepted, in principle, the recommendations made by Secretary Ickes in response to Senate Resolution 281 which requested a program for expediting the topographic mapping of the United States. The recommendations involve a 20-year program and the expenditure of $100,000,000. They would give the Geological Survey $4,000,000 for topographic surveys and maps, and the Coast and Geodetic Survey $1,000,000 for first and second-order control surveys in 1938 under such items as the Directors of the Surveys may designate.

"The Surveys and Maps Committee of the American Engineering Council earnestly hopes that steps will be taken by the Bureau of the Budget and the Congress to appropriate the minimum of five million dollars that is called for in this program. They believe that in the interest of public economy, of present immediate need, and of future conservation of our national resources, this step should be taken."

Scientific Research Legislation

The American Engineering Council has appointed a special committee to consider the ramifications of Congressman Randolph's H.R. 7939 for the promotion and coordination of Scientific Research Activities as a means for the prevention of unemployment in the future. Randolph seems to be leading a school of thought which publicly subscribes to the philosophy that an even greater application of technology to industry and business is necessary to insure that expansion of capital outlets which guarantees an increasing volume of employment.

Bill Has Aroused Much Interest

Although the Randolph Bill has not come up for action in Congress and is still subject to change, it has aroused much interest among members of the engineering profession. A number of engineers have already filed criticisms and suggestions, and Randolph informs us that he is anxious to have reactions representing all fields of technology. The Council has not formulated an official policy with reference to this legislation but the following observations are made available for the convenience of those engineers and engineering organizations who may be concerned about either federal-government support or control of research in both pure and applied science:

Bill to Coordinate Efforts

"In essence, Congressman Randolph proposes that instead of having a variety of research projects carried on by government bureaus and special research agencies seeking government funds in an unplanned way for their particular projects, that these various efforts be coordinated through the establishment of an advisory board made up of representatives of the government, of scientists, and of industry. That approach to the problem has appealed to this organization.

"You may know that last year the land-grant colleges introduced a bill proposing the establishment of engineering experiment stations in each state paralleling in general the agricultural-experiment-station idea. Since the land-grant act is administered through the Agricultural Department, the land-grant colleges believe that any development of such experiment stations should be so administered. Meanwhile, the state colleges in nineteen states—in some of which there are also land-grant colleges—sought to have this bill modified so that money could be spent at state colleges as well as at land-grant colleges in particular states. In this proposal, the administrative machinery would be located in the Bureau of Standards of the U. S. Department of Commerce.

"A third bill confused the issue further by proposing a plan for government expenditures in the field of business research, this one to be headed up in the Department of Commerce. Each of these bills has had the active support in Congress of the particular group of representatives of educational associations, the land-grant colleges having a committee and the state colleges another, the business schools having a third. Meanwhile, of course, certain government bureaus, like the Bureau of Standards and the Bureau of Mines, seek money for fundamental research and sometimes the regular functions of the government in their research efforts are confused with the proposals outlined above.

"So far, it has been impossible to secure a meeting of minds between the college groups. Within certain states, there is a feeling of sharp competition and as a result in earlier years none of the bills have succeeded in passing largely because there has been no meeting of minds in the state by which the Congressman in that state could be induced to take action.

A.E.C. Assisting in Securing Data

"It seems that Congressman Randolph is approaching this matter in a way in which some order might be brought out of this chaos. While the American Engineering Council has not committed itself to any detail of the bills, we have been assisting Mr. Randolph in securing all the information he can from all the sources, so he will have before him as complete a picture of the problem as possible before he revises his bill. Our understanding is that Congressman Randolph has the friendly support of the President in his efforts and this seemed to be an added reason, if anything was to be done in this matter, for working with Congressman Randolph in perfecting his legislation."

A Public Works Department

DEFINITE recommendations for a Public Works Department to be created in the process of government reorganization which is still before Congress are to have consideration during the eighteenth annual meeting of the American Engineering Council's Assembly in Washington on January 13, 14, and 15, 1938. Special studies by the staff and a comprehensive report of the A.E.C. Public Works Committee regarding the structure of a Public Works Department are to be ready for discussion at that time.

Engineers Favor Public Works Department

Engineers have advocated a Public Works Department for many years and now that the President's Committee on Administrative Management composed of Louis Brownlow, Charles E. Merriam, and Luther Gulick have also recommended the creation of a Public Works Department; engineers are encouraged to believe that the proposal may be due for serious consideration by this next session of Congress. It is not likely to be without opposition, however, because even the Brookings Institution which made a study for Senator Byrd's Committee failed to support the idea although they did recommend many changes in public works and engineering functions.

One of the major problems is to determine what is public works and to name those bureaus or activities among federal-government agencies which should be included in the initial structure of a Public Works Department. The President's Committee came to the conclusion that such a department should "advise the President with regard to public works" and that it should be prepared to serve other government agencies as indicated in the following quotation:

"To design, construct, and maintain large-scale public works, which are not incidental to the normal work of other departments, except as their agent on request; to administer Federal grants, if any, to state and local governments, or other agencies for construction purposes, and to gather information with regard to public works standard throughout the nation."

The complexity of the problem is indicated by the fact that neither one of the more recent studies undertook to name those engineering or public works agencies or functions which should be drawn together into a U. S. Public Works Department. The President's Committee concluded its suggestion, as follows: "The Committee does not assign to the new department particular agencies and bureaus, but leaves this assignment to the Executive when, and if, the Congress enacts a law setting up the general departmental structure."

Opinions Desired by A.E.C.

Conditions with reference to "public works" have changed materially in recent years and engineers in both public and private life have made many observations and acquired a vast amount of actual experience with public works programs. Recognizing that fact, the American Engineering Council is anxious to help to unite engineers in their public responsibility with reference to public works activities undertaken by the federal government, the several states, and local committees. To that end, engineers and engineering organizations are invited to express themselves to the A.E.C. Public Works Committee.

As a premise, one nationally known consulting engineer with a vast amount of practical experience in the construction field has suggested that "those activities of a civilian character should be allocated to such a public works department, and those for defense by the Army and Navy should remain as they are." In that connection, it has been said that "in the interest of simplicity, for the association of related activities to effect a reduction in overhead costs, for the elimination of duplication, to provide opportunities for a technical personnel of the highest type, and to facilitate the planning of government financial programs the federal government should have that concentration of public works activities which has already proved satisfactory in our states and municipalities and in the more progressive foreign countries."

(*A.S.M.E. News continued on page 984*)

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Local Sections

Coming Meetings

Anthracite—Lehigh Valley: January 28. Reading, Pa., at 8:00 p.m. Subject: "Small Boiler-Plant Equipment," by W. A. Shoudy, consulting engineer, Orrok, Myers & Shoudy, Associates, New York, N. Y.

Baltimore: January 13. Subject: "Mechanical Power Transmission and Drives," by W. Staniar, mechanical engineer, E. I. du Pont de Nemours & Co.

Boston: December 16. Dinner at 6:30 p.m.; Meeting at 7:30 p.m. at Walker Memorial, Massachusetts Institute of Technology. Subject: "America's Yachts in the 1937 International Cup Races," by Professor Zenas R. Bliss, Brown University. Coffee Talk—Professor Robert Givler of Tufts College.

Chicago: December 21. Meeting will be held in Room No. 812, 211 West Wacker Drive, Chicago, Ill., at 7:30 p.m. Subject: "The History of Steam-Power Development," by J. A. Folse, Museum of Science and Industry.

Cleveland: December 15. Guild Hall at 6:30 p.m. Subject: "Turbines and Turbine Developments," by E. L. Robinson, turbine engineering department, General Electric Co., Schenectady, N. Y.

Detroit: December 14. University of Detroit Meeting with a program arranged by student-branch members. Donald J. LaBelle will present a paper entitled "Leakage Through Unit-Type Weather-stripped Windows." Edward W. Connolly will discuss "The Engineer and Sit-Down Strikers."

Florida: December 4. College of Engineering, University of Florida, Gainesville, Fla., at 10:00 a.m. This will be a joint meeting with the Student Branch at the University of Florida, Gainesville, Fla.

Kansas City: December 11. Subject: "Air Conditioning in the Milling Industry," by Dr. Swanson, Kansas State College.

Mid-Continent: December 13. Tulsa Building, fourth floor, Tulsa, Okla., at 8:00 p.m. Subject: Student Night Meeting. One student from Oklahoma A. & M. College, University of Oklahoma, and University of Arkansas to speak.

Philadelphia: December 16. Philadelphia Engineers' Club. Cruise Night.

San Francisco: December 2. Engineers' Club, 206 Sansome St. Dinner at 6:00 p.m. Meeting at 7:30 p.m. Subject: "Central Valley Project, Its History, Power Development, and Reclamation Features," by Edward Hyatt, chief engineer, Water Resources, State of California; Lester S. Ready, chief construction engineer, National Power Survey; and Walker R. Young, construction engineer, U. S. Bureau of Reclamation.

Schenectady: December 2. Meeting to be sponsored by A.S.M.E.

Waterbury: January 19. Elton Hotel, Waterbury, Conn. Subject: "Labor Situation of Today." Business Viewpoint by J. Goss, Scoville Manufacturing Co.; Labor Viewpoint, by E. Rising, labor editor, *Business Week.*

Worcester: December 6. Joint meeting with the Worcester Engineering Society. Dinner at 7:00 p.m.; meeting at 8:00 p.m. Sanford Riley Hall, Worcester Polytechnical Institute. Subject: "Sound and How to Control It," by John A. Chambers, Member of Acoustical Society of America, and associated with the Johns-Manville Company.

Positions Available

Engineering Societies Employment Service

Sales Manager with sound merchandising ideas and proved ability to organize and handle national sales force for well-established manufacturer of light machinery, selling through two major distribution outlets, machinery and hardware stores. Must be able to develop definite, workable sales policy and make it show results. Excellent possibilities for man with initiative and knowledge of markets and men. Salary, $7000–$10,000 a year. Apply by letter giving detailed information in regard to former connections and experience. Location, New York Metropolitan Area. Y-2333.

Personnel Director with wide personnel experience embracing employment, safety, time-study, job-analysis, wage-payment systems, etc. Apply by letter. Location, East. Y-2347.

Chief Optical-Instrument Designer, not over 45. This experience is essential. Must be familiar with brass, metals, etc. Salary, $3000–$4000 a year. Apply by letter. Location, New York State. Y-2351.

Production Engineer, 30–40, with optical-instrument experience. Salary, $4000–$6000 a year. Apply by letter. Location, New York State. Y-2352.

Contact Engineer to investigate optical instruments to be developed for Army and Navy needs. Salary, $3000 a year. Apply by letter. Location, New York State. Y-2354.

Designer with experience in design of military and naval instruments. Salary, $3000 a year. Apply by letter. Location, New York State. Y-2355.

Mechanical Engineer (Diesel), young, for test and development work in connection with small Diesel engines. Work will consist of supervision, scheduling and operation of one or more engines and their equipment on performance tests; necessary calculations, curve drawing, and writing of technical reports. Involves improvements in design and other development work, largely upon own responsibility. Must be U. S. citizen. Work will last six months or year; may become permanent. Apply by letter. Location, South. Y-2359.

Executive, not over 40, to take charge of production dies, equipment, machinery, and maintenance of building and equipment. Salary, about $10,000 a year. Apply by letter. Location, Middle West. Y-2360C.

Chief Engineer, not over 45, for company manufacturing construction equipment such as road-building equipment, concrete pavers, etc. Must be good organizer. Apply by letter. Location, New York State. Y-2363.

Chief Engineer to supervise research, product design, and all engineering for national manufacturer. Must have broad experience as mechanical engineer in metal working, foundry (steel and grey iron) and product design, and proved ability as leader. Should be able to represent large, well-established company in all engineering affairs. Salary to start, $10,000–$15,000 a year. Bonus arrangement will pay more to successful applicant. Apply by letter. Location, Middle West. Y-2375C.

Executive, development engineer. Broad experience in home and industrial heating essential and ability to develop and apply equipment successfully. Position with large, well-established company. Salary to start, $6000–$7500 a year plus bonus. Apply by letter. Location, Middle West. Y-2376C.

Graduate Mechanical Engineer for work in export office. Must have practical experience in air-conditioning equipment. Knowledge of French or German desirable. Apply by letter. Location, New York, N. Y. Y-2391.

Sales Engineer, 25–35, technical graduate with two or three years' sales experience. Company represents manufacturers of silent and roller-chain drives, speed reducers, and antifriction bearings. Apply by letter. Location, New York, N. Y. Y-2392.

Tool Designer, graduate mechanical engineer, not over 50, capable of designing tools for production. Apply by letter. Location, Connecticut. Y-2393.

Sales Engineers, 25–30, for company manufacturing control valves for refrigeration and air conditioning. Must have sales experience. Salary, $175 a month. Apply by letter. Location, New England. Y-2395.

Mechanical Engineer, about 25, graduate of engineering college of recognized standing. Must have at least two years' practical experience in design work. Oil-refinery experience preferred. Apply by letter. Location, New York, N. Y. Y-2398.

(*A.S.M.E. News continued on page 986*)

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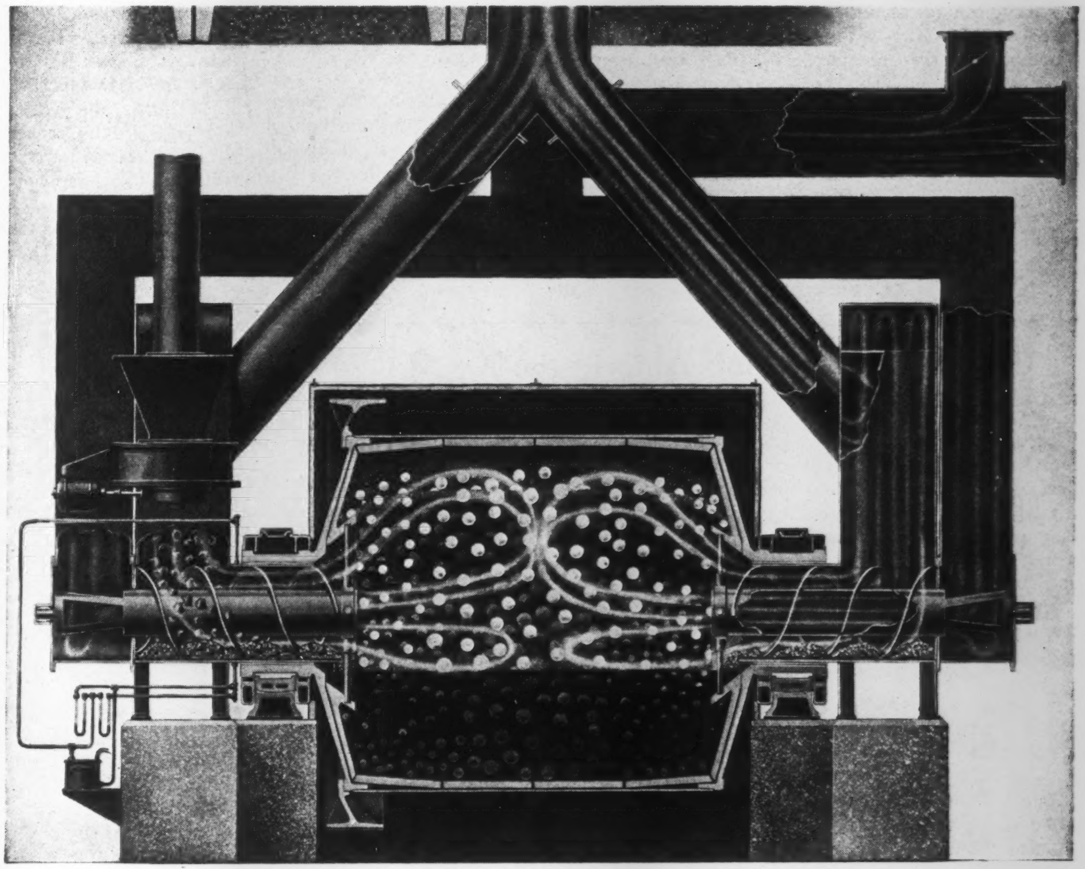

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Designer, 30–35, for heavy machine guns or cannons. Experience in automatic machinery with close tolerances will be considered. Salary, $2000 a year. Apply by letter. Location, New York State. Y-2400.

Maintenance Engineer, 35–40, graduate mechanical engineer with dry-color, cement-plant, or lithopone-plant experience. Salary, $275 a month. Apply by letter. Location, New Jersey. Y-2409.

Mechanical Engineer, 35–45, to act as chief engineer for railway-supply manufacturer. Experience in locomotive design or as mechanical engineer for railroad is essential. Will have charge of development as well as day-to-day engineering design work. Salary, $6000–$7500 a year. Apply by letter. Location, Pennsylvania. Y-2410.

Time-Study Engineer, about 30, experienced, knowing something about cutting-tool business. Company produces all kinds of metal-cutting tools such as taps, dies, reamers, milling cutters, etc. Work will consist principally of timing operations. Opportunity. Apply by letter. Engineer residing in Connecticut preferred. Y-2413.

Candidates for Membership in the A.S.M.E.

The application of each of the candidates listed below is to be voted on after December 24, 1937, provided no objection thereto is made before that date, and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the secretary of The American Society of Mechanical Engineers at once.

NEW APPLICATIONS

Allen, Jas. H., Tarrytown, N. Y.
Ayres, R. W., Chicago, Ill. (Rt)
Balleisen, Chas. E., Aberdeen Proving Grounds, Md.
Bangs, John R., Ithaca, N. Y.
Becker, Wm. M., Brookings, S. D.
Behn, Carl, Springfield, Ohio
Bergstrom, Albert L., Canton, Ohio
Boysen, Jens, San Francisco, Calif.
Brooks, Ernest A., Barberton, Ohio
Cerny, Jos. A., Cleveland, Ohio
Copp, Lowell J., West Alexandria, Ohio
Crain, R. W., Seattle, Wash.
Davies, Ray E., San Marino, Calif.
Deutschman, Meyer W., New York, N. Y.
Ehmann, Roy Leon, Pittsburgh, Pa.
Esdaile, H. M., Montreal, Quebec, Canada
Gamboa, F. R., New York, N. Y.
George, Everett D., Cuyahoga Falls, Ohio
Giordano, Jos., Philadelphia, Pa.
Gray, E. S., Columbia, Mo.
Gruetjen, Fredk. A., Los Angeles, Calif.
Gurwick, Irving, Mt. Vernon, Ohio
Guy, J. M., Jr., Erie, Pa.
Hagemann, John R., Milwaukee, Wis.
Herberts, C. A., Hollywood, Calif.
Horne, Arthur W., Palmerton, Pa.
Jakob, Max, Chicago, Ill.
Kershner, Stuart G., Houston, Tex.
Kurtz, Henry F., Rochester, N. Y.
Lemmon, J. R., Cincinnati, Ohio
Lindquist, W. E., Cincinnati, Ohio
MacKendrick, J. N., Olean, N. Y. (Rt & T)
Macomber, Henry E., Detroit, Mich.
McCarey, J. N., Timiskaming, Que., Canada
McKimmey, J. A., St. Joe, Ark.
Michelsen, Henry, Bristol, Conn.
Nofsinger, C. W., Summit, N. J. (Rt & T)
Noor, Robert A., Tuscumbia, Ala.
Obert, Edw. F., Evanston, Ill.
Palm, Bernhard N., South Pasadena, Calif.
Rollow, Douglas K., Los Angeles, Calif.
Simpson, Richard W., Waterbury, Conn.
Smith, Bernard, Oakland, Calif.
Soomil, Edw., Los Angeles, Calif.
Spenner, Fred Henry, St. Louis, Mo.
Sprau, B. W., Erie, Pa.
Stephenson, Wm. B., Philadelphia, Pa.
Tamaro, George S., Brooklyn, N. Y.
Tuttle, R. B., Mt. Vernon, Ill.
Vail, Robert P., Lubbock, Tex.
Van, Warren McFarland, San Francisco, Calif.
Witte, Herman, Woodside, L. I.
Woods, John M., San Francisco, Calif.
Zeffren, Henry E., St. Louis, Mo.
Zinck, W. C., New Britain, Conn. (Rt & T)

CHANGE OF GRADING

Transfers from Member

Lipetz, A., Schenectady, N. Y.
Peaslee, W. D. A., Kansas City, Mo.
Shoudy, W. A., Maplewood, N. J.

Transfer from Associate

Kimball, Arthur L., Schenectady, N. Y.

Transfers from Junior

Alberts, Matthew A., Brooklyn, N. Y.
Anderson, Ernest E., Detroit, Mich.
Davis, C. R., Toronto, Ont., Can.
Eckstrom, Albert W., Buffalo, N. Y.
Hartenberg, Richard S., Madison, Wis.
Howe, Everett D., Berkeley, Calif.
Keller, Edwin, New York, N. Y.
Krueger, H. F., Toledo, Ohio
Lasciak, Charles, Brooklyn, N. Y.
Lastner, Charles Andrew, Baltimore, Md.
Oonk, W. J., St. Louis, Mo.
Repscha, Albert H., Philadelphia, Pa.
Schmidt, Harry P., Brooklyn, N. Y.
Weir, T. A., Paris, France
Zaffarano, Vincent M., Jackson Heights, L. I., N. Y.

Necrology

The following deaths of members have recently been reported to the office of the Society:

Bird, John C., May 19, 1937
Brady, John J., September 17, 1937
Burhorn, Edwin, September 26, 1937
Felton, Edgar C., September 18, 1937
Haines, Edward P., October 16, 1937
Hartig, Rudolph K., June 9, 1937
Howell, Frank B., October 10, 1937
Kantrow, Melville W., October 15, 1937
Lindstrom, John A., September 28, 1937
Lukens, A. N., October 20, 1937
Lyall, William L., April 15, 1937
Miner, N. A., September 7, 1937
McDonald, Donald, October 8, 1937
Parry, E. Mason, October 4, 1937
Rosenfelt, Samuel D., August 29, 1937
Spear, Maynard H., May, 1937
Stewart, William Fraser, September 9, 1937
Taylor, Roger, April 27, 1937
Tsvetkoff, Alexis P., August 3, 1937

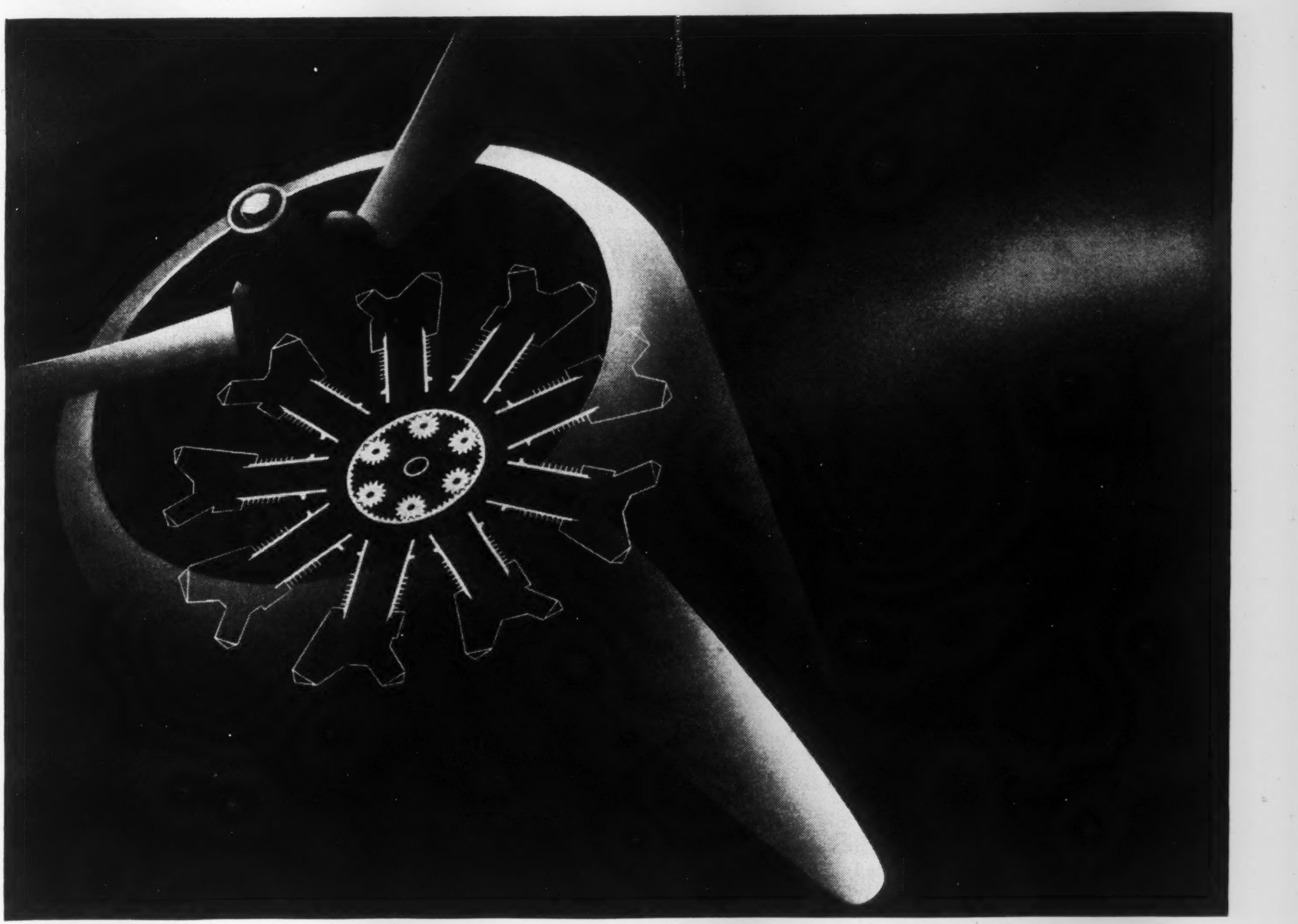
A.S.M.E. Transactions for November, 1937

The November, 1937, issue of the Transactions of the A.S.M.E., contains the following papers:

Further Studies of Three-Dimensional Pipe Bends (FSP-59-13), by William Hovgaard
Air Chambers for Discharge Pipes (HYD-59-7), by Lorenzo Allievi
Air Chambers and Valves in Relation to Water Hammer (HYD-59-8), by R. W. Angus
Hydraulic Phenomena in Fuel-Injection Systems for Diesel Engines (HYD-59-9), by K. J. DeJuhasz
Operation of Emergency Shutoff Valves in Pipe Lines (HYD-59-10), by F. Knapp
Complete Characteristics of Centrifugal Pumps and Their Use in the Prediction of Transient Behavior (HYD-59-11), by R. T. Knapp
Experiments and Calculations on the Resurge Phase of Water Hammer (HYD-59-12), by J. N. LeConte
Comparisons Between Calculated and Test Results on Water Hammer in Pumping Plants (HYD-59-13), by O. Schnyder
Relation of Relief-Valve and Turbine Characteristics in the Determination of Water Hammer (HYD-59-14), by Earl B. Strowger
The Application of Heaviside's Operational Calculus to the Solution of Problems in Water Hammer (HYD-59-15), by F. M. Wood
Mechanical Processing of Vegetable Oils (PRO-59-10), by W. W. Moss, Jr.
Running-In Characteristics of Some White-Metal Journal Bearings (RP-59-9), by S. A. McKee & T. R. McKee
Investigation of the Oxidation of Metals by High-Temperature Steam (RP-59-10), by A. A. Potter, H. L. Solberg, and G. A. Hawkins
Air Conditioning of Railroad Passenger Cars (RR-59-5), by L. W. Wallace and G. G. Early, Jr.
Colors and Gums Used in Textile Printing (TEX-59-4), by Ivan F. Chambers

DISCUSSION

On previously published papers by Messrs. G. L. Arms; T. Fraser; J. Griffen; W. S. Pardoe; M. P. O'Brien and R. G. Folsom; B. J. Cross; and C. M. Larson



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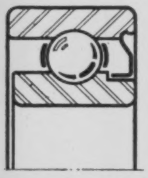
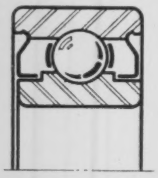
A New Self-Sealed, Feltless Precision Bearing by Norma-Hoffmann

Norma-Hoffmann Bearings Corporation, Stamford, Conn., announces its new "9000" Series of Self-Sealed Precision Ball Bearings, offered in two types—the "9000-D" Series, with single side shield, and the "9000-DD" Series, with two side shields. These bearings employ inwardly extending, closely-fitted flanged shields of advanced type, which do not rotate or contact with rotating seal parts, are equally effective in retaining grease in a horizontal or vertical position and, not being subject to any wear whatsoever, permanently maintain their efficiency.



"9000-D"



"9000-DD"

The metal seals clear the recess on the inner ring, obviating the possibility of drag or frictional resistance. Consequently, there is no power loss—which means higher speeds and increased efficiency in certain types of units. The shields occupy less space within the bearing than the standard felt seal, and the "9000" Series has greater grease capacity and a more lasting lubricant supply for long continuous service. In the "9000-DD" type, the bearings are totally sealed against the entrance of dirt or foreign matter during assembly, operation or disassembly, providing absolute cleanliness at all times. Available in a full range of sizes and interchangeable with single felt seal bearings of the wide outer ring type from 6 m/m to 26 m/m in bore, this series is fully described in catalog F-951-B.

New Mechanical Book Describes Solution of Metal Problems

A new booklet describing the solution to scores of actual metal problems as encountered by the engineer has just been issued by The International Nickel Company, 67 Wall Street, New York, N. Y. Containing 48 pages, illustrated throughout, this booklet has been prepared primarily as a guide book to Monel and other non-ferrous nickel alloys in the fields of engineering applications. It also covers the corrosion resistance and other properties of these metals.

The booklet includes 20 sub-divisions, each devoted to specific problems in fields from hydroelectric and steam power plants to highway maintenance, refrigeration and automobiles.

Besides going into details of standard Monel the booklet describes some of the newer forms of this alloy, including "K" Monel, "S" Monel and the like. The nonmagnetic forms of the metal are also covered in a special section devoted to airplanes and the like. Inconel, the high nickel-chromium alloy, is another subject covered.

Special items included are those dealing with meters and other regulating equipment, sewage disposal, pump maintenance and other items of general interest. The booklet is available without charge to members of all branches of the engineering profession.

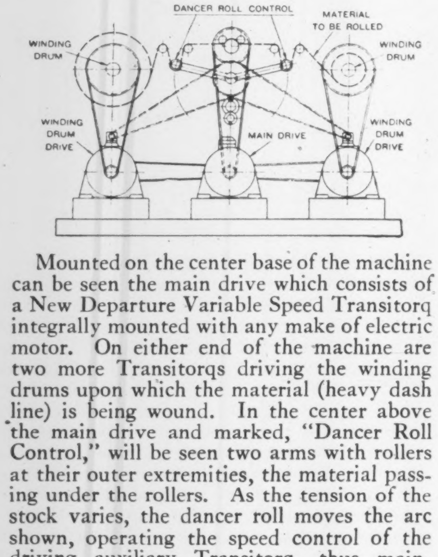
Morris Screw Pumps

Engineers of municipal plants and government or industrial projects, where large quantities of water are to be handled at moderate heads, will be interested in a new bulletin on Screw Pumps which has just been published by Morris Machine Works. The bulletin outlines the development of this interesting type of centrifugal pump, explains its applications, and describes the special features of the Morris design which has developed efficiencies in excess of 90 per cent in many installations for handling sewage, drainage water, and water for irrigation service, condenser circulation, etc. The bulletin is illustrated by exterior views of both horizontal and vertical types, a sectional diagram showing the construction of the pump, and complete dimensions for sizes ranging from 20 to 40 in. Copies of the bulletin may be obtained by addressing Morris Machine Works, Baldwinsville, New York, and asking for Bulletin 162.

New Departure Announces Dancer Roll Tension Control

Illustrated below is the demonstration unit which was exhibited at the recent POWER SHOW, New York by New Departure, Division General Motors Corp., Bristol, Conn. This demonstrator was the first public announcement of their newly developed Dancer Roll Tension Control applicable to the New Departure Variable Speed Transitorq.

For the purpose of illustrating the function of this control, the machine is designed to wind a roll of paper (this might be strip steel, cloth, or any similar material) up to 21″ in diameter in the process of which the speed of the Transitorq is adjusted to match the increasing diameter of the wound roll.

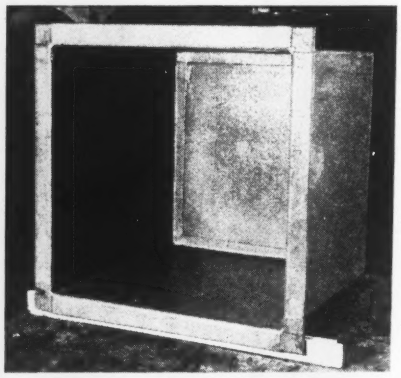


Mounted on the center base of the machine can be seen the main drive which consists of a New Departure Variable Speed Transitorq integrally mounted with any make of electric motor. On either end of the machine are two more Transitorqs driving the winding drums upon which the material (heavy dash line) is being wound. In the center above the main drive and marked, "Dancer Roll Control," will be seen two arms with rollers at their outer extremities, the material passing under the rollers. As the tension of the stock varies, the dancer roll moves the arc shown, operating the speed control of the driving auxiliary Transitorq, thus maintaining a constant surface speed and constant tension of the material in process.

As the roll builds up on one end of the machine to the maximum diameter, i.e., when it has been exhausted on the opposite end, this demonstrator automatically reverses. This point is brought out because this is not primarily the objective intended, the machine having been designed this way simply to facilitate the operation thereof rather than having to unload and reload at the end of every roll.

Koroseal Tank Linings

One of the newest applications for Koroseal, a synthetic rubber-like material developed by The B. F. Goodrich Company, Akron, Ohio, is its use as a lining for tanks handling severe corrosives.



Among Koroseal's outstanding properties is its great resistance to oxidizing solutions which makes it a desirable construction material for lining tanks and other equipment to resist nitric acid, chromic acid and mixtures of nitric and hydrofluoric acids.

Methods of attaching Koroseal to steel, wood and cement have been developed which yield very good adhesion to the base material. Lining cannot be applied to riveted tanks, but welded constructions are very satisfactory. Typical installations of Koroseal lining include steel tanks for handling 67% nitric acid at 130° F. and wood tanks for stainless steel pickling handling a mixture of nitric and hydrofluoric acids. These tanks have been in service for over a year and are still in excellent condition.

Koroseal, being rubber-like in nature, is susceptible to physical damage. It is also thermoplastic and, therefore, is not recommended for service where the actual temperature of liquids in contact with the material exceed 150° F. However, the hazards of physical damage can be eliminated by the application of brick or other protective sheathings over the lining. Where it is desired to use Koroseal in steel vessels at temperatures above 150° F., sheathings of insulating material, such as brick, can be applied over the Koroseal in sufficient thickness to bring the actual contact temperature down to the required minimum.

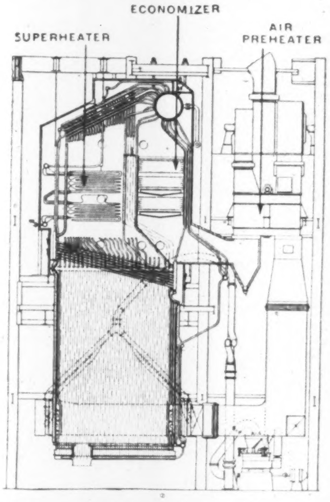
Repairing of a damaged Koroseal lining is an extremely simple matter. No heat or pressure is required. A few hours' drying time for the Koroseal liquids is all that is required, and the repair is as strong as the original material.

1936 DEVELOPMENTS IN

SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS

There has been a marked tendency on the part of the operators of large boiler units equipped with Elesco superheaters, to also install Elesco economizers and Ljungstrom air preheaters. These equipments provide coordinated performance.

SUPERHEATERS



Cross-sectional view of one of four C-E boilers in a leading metropolitan public utility station. Originally two of the boilers were equipped with Elesco products; a repeat order accounted for Elesco equipment in the other two boilers.

The trend in superheater design is definitely to higher pressures and temperatures, with a consequent increase in efficiency and economy. There has also been a general employment of controlled gas flow to give a constant superheat over a wide range of ratings and operating conditions.

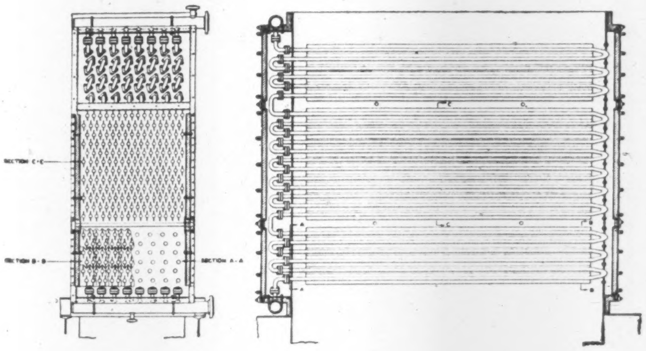
Some of the prominent superheater orders received during 1936 are listed. Attention is called to the high operating conditions.

	Boiler	Pressure Lb. per Sq. In.	Superheat Deg. F.	Final Temp. Deg. F.
Container Corp., Carthage, Ind.	1 CE-SV 820 hp.	575	186	660
Hummel Ross Fibre Co., Hopewell, Va.	1 CE-SV 438 hp.	180	95	475 (waste heat)
Wilson & Co., Albert Lea, Minn.	3 CE-SV 482 hp.	290	106	525
Appalachian Electric Power Co., Logan, W. Va.	1 CE-SV 2080 hp.	1325	345	925
N. Y. Edison Co., Waterside Station No. 2, New York, N. Y.	4 CE-XD	1280	323	900
Sanitary District of Chicago	1 CE-SV 925 hp.	400	302	750
United Power Mfg. Co., Riverside Station, Iowana, Iowa	1 CE-SV 802 hp.	860	296	825
Gulf States Utilities Co., Beaumont, Tex.	1 CE-SV 1000 hp.	875	385	915
Byllesby Engr. & Management Corp., Minot, N. D.	1 Vogt XD 716 hp.	165	125	498
City Water & Light Plant, Jonesboro, Ark.	1 Murray LD 540 hp.	200	100	488

ECONOMIZERS

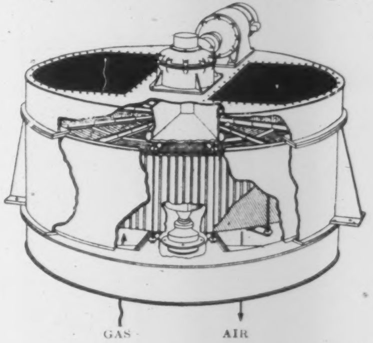
Elesco economizer design has kept pace with the rapidly increasing pressures and temperatures of modern boiler units; a number of installations have been made with the economizer located within the boiler, in the space normally occupied by the tubes of the last pass. This is made possible by the use of fin tubes, Elesco forged return bends and bifurcations, which provide the maximum heat recovery in the minimum space. High rates of heat transfer are obtained with the Elesco fin tube economizer with a minimum draft restriction. Due to the method of construction, the entire economizer is readily accessible. Representative orders for large capacity economizers received during 1936 are—

	Boiler	Pressure Lb. per Sq. In.	Water Lb. per Hr.	Final Water Temp. Deg. F.
Gulf States Utilities Co., Beaumont, Texas	CE-SV	925	320,000	453
Pittsburgh Plate Glass Co., Columbia Chemical Divn., Barberton, Ohio	Connelly SV	400	125,000	334
N. Y. Edison Co., Waterside Station No. 2, New York, N. Y.	CE-XD	1400	500,000	506
Appalachian Electric Power Co., Logan, W. Va.	CE-SV	1425	1,000,000	516
Department of Public Utilities, Cleveland, Ohio	Connelly SV	350	100,000	310



AIR PREHEATERS

Recognition of the superiority of the Ljungstrom regenerative counterflow air preheater design by American industries and public utilities is being reflected in the large increase in orders for Ljungstrom air preheaters received during the past year. They are uniquely suited to today's operating conditions, as their highest efficiencies are obtained in boilers operating under high steam temperatures and pressures. A few of the orders received during 1936 are listed below.



	Boiler	Air Preheated Lb. per Hr.	Exit Air Temp. Deg. F.
Appalachian Electric Power Co., Logan W. Va.	CE-SV	990,000	549
N. Y. Edison Co., Waterside Station No. 2, New York, N. Y.	CE-XD	490,000	509
Gulf States Utilities Co., Beaumont, Tex.	CE-SV	342,500	517
Sinclair Refining Co., East Chicago, Ind.	Stills	77,000	1115
Sanitary District of Chicago	Sewage Disp.	135,000	1150
Indianapolis Power & Light Co., Indianapolis, Ind.	Connelly	360,000	520
Buick Motor Car Co., Flint, Mich.	B & W	133,300	584
Brooklyn Manhattan Transit Co., Williamsburg Power House, Brooklyn, N. Y.	B & W	559,000	431

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The Standards COLUMN

News of Interest to Manufacturers

Resume of Present Status - - -
STANDARDS COMMITTEES
for which the A.S.M.E. is Sponsor or Joint Sponsor under the Procedure of the American Standards Association

Since the organization of the A.S.A. in October, 1918 the A.S.M.E. has reorganized all of its existing committees dealing with dimensional standards and specifications under the procedure of that association and has accepted in all sponsorship or joint sponsorship for thirty-two (32) separate projects under that procedure. The following tabulation will be of interest to those engaged in the industries affected by this activity.

Name and No. Sectional Committee	Sponsors Initials	Date Organized	No. Sub. Comm. and Subgroups	Standards Completed	Standards Published	Committee Memberships	No. of Coop. Organizations
B1 Standardization and Unification of Screw Threads	S.A.E. A.S.M.E.	June 1921	14	2	1	118	20
B2 Pipe Threads	A.G.A. A.S.M.E.	1913	8	1	1	98	24
B3 Ball and Roller Bearings	S.A.E. A.S.M.E.	Dec. 1920	2	1	1	28	6
B4 Allowances and Tolerances for Cylindrical Parts and Limit Gages	A.S.M.E.	June 1920	2	1	1	60	25
B5 Small Tools and Machine Tool Elements	N.M.T.B.A. S.A.E. A.S.M.E.	Feb. 1922	20	13	9	34	4
B6 Gears	A.G.M.A. A.S.M.E.	June 1921	10	2	2	92	13
B16 Pipe Flanges	H.P.A.C.C.N.A. M.S.S.V.F.I. A.S.M.E.	Oct. 1921	16	10	9	270	34
B17 Shafting	A.S.M.E.	Oct. 1918	5	5	5	48	10
B18 Bolt, Nut and Rivet Proportions	S.A.E. A.S.M.E.	Mar. 1922	16	9	8	159	22
B26 Fire Hose Coupling Screw Threads	A.W.W.A. N.B.F.U. A.S.M.E.	1913	2	1	1	10	5
B27 Plain and Lock Washers	S.A.E. A.S.M.E.	Aug. 1925	2	0	0	85	15
B29 Transmission Chains and Sprockets	S.A.E. A.G.M.A. A.S.M.E.	Sept. 1917	3	1	1	26	6
B31 Code for Pressure Piping	A.S.M.E.	Mar. 1926	15	1	1	196	44
B32 Wire and Sheet Metal Gaging Systems	S.A.E. A.S.M.E.	Nov. 1927	3	0	0	47	18
B33 Screw Threads For Hose Couplings	A.S.M.E.	Aug. 1928	2	1	1	30	21
B36 Wrought Iron and Wrought Steel Pipe and Tubing	A.S.T.M. A.S.M.E.	Apr. 1928	5	1	1	103	28
B40 Pressure and Vacuum Gages	A.S.M.E.	July 1930	4	1	0	99	34

(*Continued on Page 20*)

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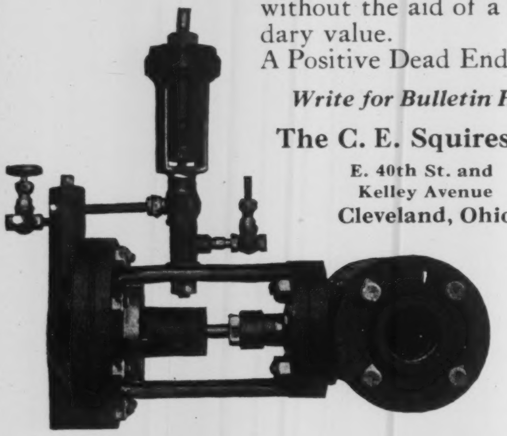

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News of Interest to Manufacturers

Resume of Present Status - - - STANDARDS COMMITTEES for which the A.S.M.E. is Sponsor or Joint Sponsor under the Procedure of the American Standards Association

(*Continued from Page 18*)

Name and No. Sectional Committee	Sponsors Initials	Date Organized	No. Sub. Comm. and Subgroups	Standards Completed	Standards Published	Committee Memberships	No. of Coop. Organizations
B41 Stock Sizes, Shapes and Lengths for Hot and Cold Finished Iron and Steel Bars	A.S.M.E.	Apr. 1929	3	0	0	52	21
B42 Specifications for Leather Belting	A.S.M.E.	Feb. 1931	2	0	0	43	21
B43 Machine Pins	S.A.E. A.S.M.E.	Mar. 1926	2	0	0	19	10
B45 Foundry Equipment and Supplies	A.F.A. A.S.M.E.	Feb. 1931	3	0	0	53	22
B46 Classification and Designation of Surface Qualities	S.A.E. A.S.M.E.	May 1932	10	0	0	178	34
B50 Combustion Space for Solid Fuels	A.S.M.E.	June 1933	5	0	0	49	20
A13 Scheme for Identification of Piping Systems	N.S.C. A.S.M.E.	June 1922	4	1	1	59	29
A40 Plumbing Equipment	A.S.S.E. A.S.M.E.	Aug. 1928	19	2	2	236	22
C28 Electric Motor Frame Dimensions	N.E.M.A. A.S.M.E.	Nov. 1927	1	0	0	39	23
C44 Rolled Threads for Screw Shells of Electric Sockets and Lamp Bases	N.E.M.A. A.S.M.E.	Mar. 1929	1	1	1	27	9
Z10 Letter Symbols and Abbreviations for Science and Engineering	A.A.A.S. A.I.E.E. A.S.C.E. A.S.M.E. S.P.E.E.	Jan. 1926	10	7	7	188	34
Z14 Drawings and Drafting Room Practice	S.P.E.E. A.S.M.E.	July 1926	6	2	2	117	32
Z15 Standards for Graphic Presentation	A.S.M.E.	Nov. 1926	7	1	0	81	24
Z18 Speeds of Machinery	A.S.M.E.	May 1928	3	0	0	49	27
Z32 Graphical Symbols and Abbreviations for Use on Drawings	A.I.E.E. A.S.M.E.	Jan. 1926 May 1936	11	6	6	116	42
TOTALS			216	70	61	2809	....

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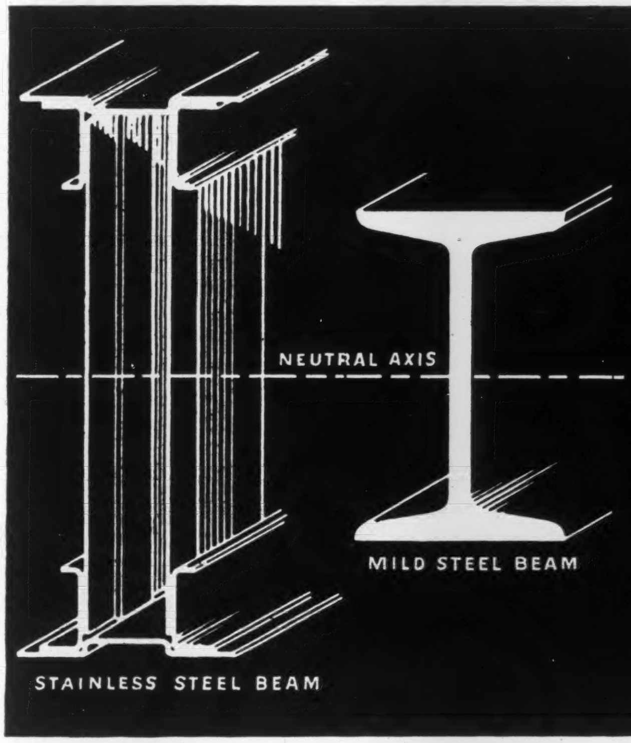

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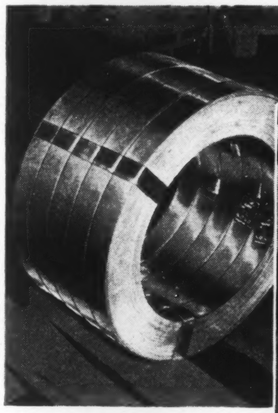
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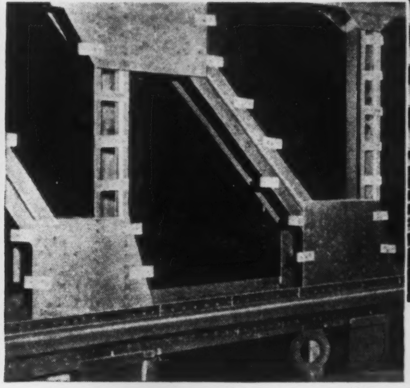
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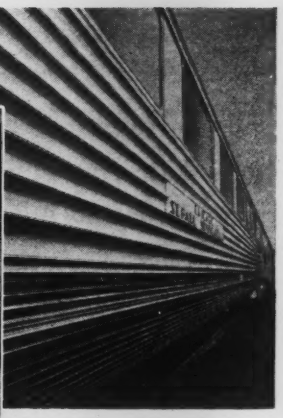
D

FROM COLD-ROLLED COILS to FINISHED TRAIN . . . the stronger, lighter construction of Budd's famous stream-lined stainless steel trains is as plain as A,B,C! Coils of cold-rolled stainless steel strip (A) are quickly drawn through three pairs of rolling dies (B), emerge as angles, channels, "Z" sections, etc., which are then neatly "Shotwelded" into light-weight trusses (C) of tremendous strength. The trusses are packed with highly efficient insulation; stainless steel siding is attached onto the small tabs; and presto! the car (D) is structurally complete. Since there are no rivet holes (the small marks which look like rivets are actually "Shotwelds"), and since it is known in advance that there can be no loss of metal by corrosion, the full strength of the stainless steel can be used, every needless pound eliminated.

U·S·S STAINLESS STEEL

AMERICAN STEEL & WIRE COMPANY · *Chicago and New York*
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NATIONAL TUBE COMPANY · *Pittsburgh*

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UNITED STATES STEEL

AJAX
AJAX ACCURACY LETS YOU LINE UP MACHINES BY MEANS OF THE COUPLING
NO NOISE NO BACK LASH
GRAPHITED BRONZE BEARINGS AND RUBBER BUSHINGS REQUIRE NO LUBRICATION

Ajax Flexible Couplings protect direct connected machinery by combining Positive Drive . . . Resilient Flexibility . . . Protection against Misalignment . . . Free End Float . . . Long Life Dependability. Built to give Service—not require it. Write for your copy of the Ajax Data Book.

Ajax Flexible Coupling Company
Manufacturers of Flexible Couplings since 1920
112 English Street WESTFIELD, N. Y.
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214 STOCK SIZES IN FINISHED BUSHINGS

ELEPHANT BRAND PHOSPHOR BRONZE

Twelve inch stock bushing bars, which have been furnished for years cast in the rough, are now offered machined with 1/32″ plus O.D. and 1/32″ minus on the I. D. up to and including 3″ diameter . . . also, from 3″ up to 6″ inclusive, with 1/16″ plus O. D. and 1/16″ minus on the I. D. Maximum I. D. S-4. There's plenty of stock to machine down to size . . . yet you save tool-upkeep and costly waste from machining rough castings.

Write for stock and price lists.

THE PHOSPHOR BRONZE SMELTING CO.
2208 Washington Avenue, Philadelphia, Pa.

Concerning . . . . A.S.M.E. ACTIVITIES

AWARDS

The Society annually makes nine awards, upon the recommendation of the Board of Honors and Awards, a "standing committee," and the Committee on Medals which is composed of the Board and fifteen members of the Society. The awards are described in the following statement:

A.S.M.E. Medal, established by the Society in 1920 to be presented for distinguished service in engineering and science. May be awarded for general service in science having possible application in engineering.

Holley Medal, instituted and endowed in 1924 by George I. Rockwood, Past Vice-President of the Society, to be bestowed for some great and unique act of genius of engineering nature that has accomplished a great and timely public benefit.

Worcester Reed Warner Medal, provision for which was made in the will of Worcester Reed Warner, Honorary Member of the Society, is a gold medal to be bestowed on the author of the most worthy paper received, dealing with progressive ideas in mechanical engineering or efficiency in management.

Melville Medal, established in 1914 by the bequest of Rear-Admira George W. Melville, Honorary Member and Past-President of the Society, to be presented for an original paper or thesis of exceptional merit, presented to the Society for discussion and publication, to encourage excellence in papers. The medal may be presented annually.

Spirit of Saint Louis Medal, endowed by members of the Society and citizens residing in St. Louis, Mo., to be awarded for meritorious service in the field of aeronautical engineering. This medal will be awarded at the discretion of the Council of the Society at approximately three-year periods upon the recommendation of a Spirit of Saint Louis Medal Board of Award made up of six members, each appointed for a term of nine years and the terms of two members expiring at each three-year period. The St. Louis Section and the Aeronautic Division will each be responsible for the nomination of three members.

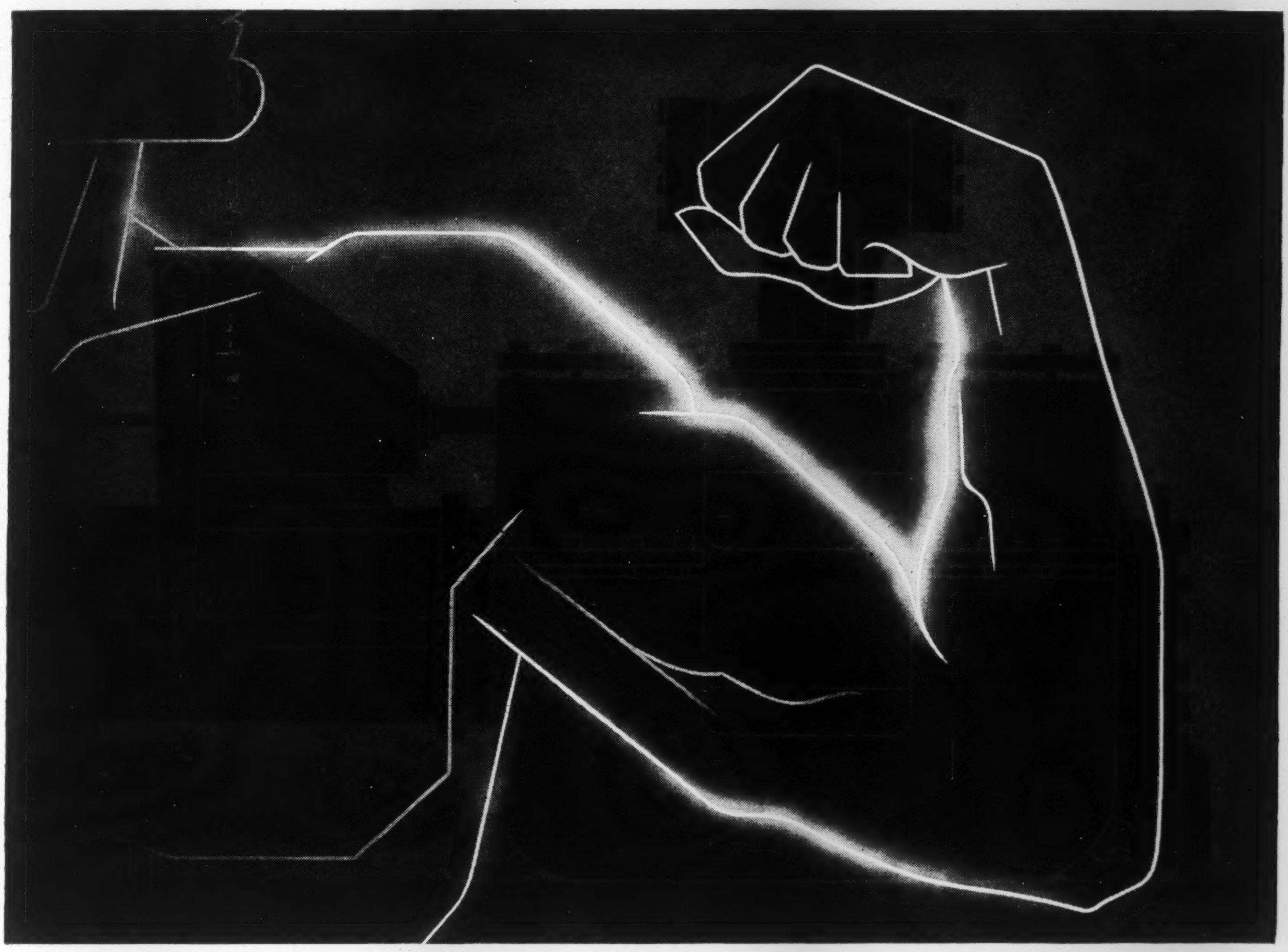
Junior Award, annual cash award of $50, established in 1914, from a fund created by Henry Hess, Past Vice-President of the Society, to be presented, together with an engraved certificate, for the best paper or thesis submitted by a Junior Member.

Charles T. Main Award, annual cash award of $150, established in 1919 from a fund created by Charles T. Main, Past-President of the Society, to be awarded to a Student Member of the Society, for the best paper within a general subject on the influence of the profession upon public life. The exact subject is assigned by the Board of Honors and Awards, subject to the approval of the Council, and is announced each year through the Honorary Chairmen of the Student Branches.

Student Awards, two annual cash awards of $25 each, one undergraduate and one postgraduate, established in 1914, from a fund created by Henry Hess, Past Vice-President of the Society, to be presented, together with engraved certificates, for the best papers or theses submitted by Student Members.

For further information—address

The American Society of Mechanical Engineers
29 W. 39th St., New York, N. Y.



SINEWS FOR SERVICE

IF THE service is tough — so are Moly irons and steels. Take slush pumps in the oil fields . . . driven continuously and operating under severe conditions.

Since no pump is better than its parts, many pump builders use Moly irons and steels for the vital parts . . . because they have proved their capacity to withstand the toughest going.

One manufacturer, for example, uses carburized Nickel-Moly (SAE 4615) for pump cylinders. It was selected primarily because it takes a case impervious to the abrasion of well cuttings; and pressure is always constant. Minimum distortion from heat-treating was also a factor. . . . Just one of many cases where Moly steel or iron has settled a difficult problem — to the mutual advantage of the manufacturer and the user of the product. From either standpoint, Moly steels and irons will prove well worth their investigation.

Our technical books, "Molybdenum in Steel" and "Molybdenum in Cast Iron," will be found of unusual interest to engineering and production heads in any industry using or producing ferrous products. A simple request brings either or both — and, if desired, puts your name on "The Moly Matrix" monthly mailing list. Our experimental laboratory facilities are available for the study of any special problem in alloy steel or iron. Climax Molybdenum Company, 500 Fifth Avenue, New York City.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

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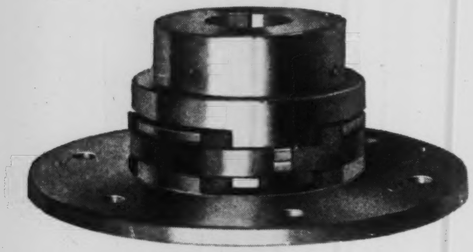
Longitudinal Space Saved by New L-R Flexible Couplings

Lovejoy Flexible Coupling Co., 4957 West Lake Street, Chicago, announce an L-R coupling of new design—the Type WF, which is made with one of the bodies in the form of a flange which bolts onto the flywheel or a clutch or brake drum of a Diesel, gas or steam engine.



The flange-body design reduces the overall length of this coupling by one-third. A recently installed WFR-800 coupling, capable of carrying a load of 324,000 inch pounds, extends less than 6 inches beyond the rim of the flywheel. It is apparent that this saving of space at an important point, allowing many more inches for frame and other parts, must add considerably to the efficiency and life of both drive and driven unit. The L-R Type WF Flexible Coupling will be made in sizes from 3″ to 14″ bores suitable for 2500 H. P. at 100 R.P.M.

As on the well known L-R Type W, free floating load cushions are held in place by a quickly removable outside retaining spring. This permits larger hubs and greater load carrying surfaces with consequently increased carrying capacity. The load cushions are always in plain sight and can be removed and replaced in a few minutes without tearing down the coupling. This principle has been thoroughly tested in seven years of service.

Three types of resilient cushioning material are available for each of these couplings: Metalflex Cushions, Leather Load Cushions, and Multiflex Cushions. By application of suitable materials and design, capacities may be increased without change in overall dimensions. For further information, details and literature on the new coupling, address the manufacturer.

New Fairbanks-Morse Diesel Bulletin

An attractive booklet has just been issued by Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill. This booklet illustrates and describes present models in the complete line of Fairbanks-Morse Diesel engines. An introduction traces briefly the development and explains the operation and uses of Diesels. Along with the illustrations and discussions of operating features of the various F-M models, are given applications in marine, stationary and portable service; in some cases typical installations are pictured and described.

Fairbanks, Morse & Co. is the largest manufacturer in the country of a complete line of Diesel engines, offering 4-cycle, 2-cycle with automatic scavenging and 2-cycle with pump scavenging models for economical, dependable service wherever power is used. Fairbanks-Morse Diesel engines in use total nearly 3,000,000 horsepower, representing a background of experience that assures the best in Diesel design and manufacture. To advanced design, modern manufacturing methods, skilled workmanship and use of materials of the highest grade can be attributed the outstanding success of Fairbanks-Morse Diesel engines.

Johns-Manville Announces New Insulating Brick

Johns-Manville has recently placed on the market a new type of 2000-degree insulating brick known as "JM-20." This new brick, fully protected by Johns-Manville owned patents, was developed by the company's Research Laboratories for use behind refractory walls in various types of high temperature industrial equipment, including boiler settings, ceramic kilns, steel plant equipment, and practically all types of furnaces. It can also be used for direct exposure at temperatures up to 2000-degrees F. wherever there is no flame impingement; slag action or mechanical abrasion.

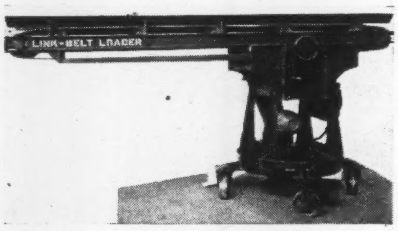
Research on basic raw materials used in refractory insulations led to the development of JM-20 Insulating Brick. This new type of insulating refractory is produced by combining a high quality refractory clay with a specially manufactured fibrous, light weight, inorganic aggregate. JM-20 Insulating Brick is unusually light in weight, weighing less than 1.7 lbs. per standard 9-inch equivalent. Its heat capacity is unusually low—less than one-quarter that of ordinary refractories—and its thermal conductivity is less than one-sixth that of fire brick. Data sheets giving full particulars on JM-20 Insulating Brick may be obtained from any Johns-Manville office.

New Link-Belt Box Car Loader Announced

Announcement is made by Link-Belt Company, 2045 W. Hunting Park Ave., Philadelphia, of the development of a new type of inexpensive box car loader for handling bulk materials without creating a lot of dust or degradation in the loading operation.

The anti-friction belt conveyor constituting the loading element of the machine, is supported on a horizontal boom which is arranged so it can be racked back and forth, or rotated 360 degrees, by hand, on the castor-mounted truck on which boom is mounted. The conveyor is operated at a comparatively slow speed, and has a discharge height of 5 feet.

It is stated that in handling pebble lime with one of these loaders at an eastern lime-preparing plant, the degradation due to loading is practically eliminated, and that the amount of dust created has been reduced to a very desirable degree.



Being mounted on four large swiveling castors, it is possible for three men to move the machine into and out of cars. After it is in place, the services of but one man are required.

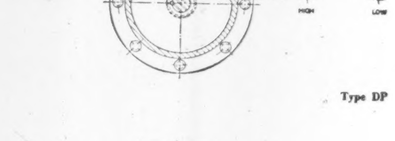
Welding Pipe Lines

An improved welding method used in the construction of over 5,000 miles of cross-country pipe lines is discussed in "Lindewelding Pipe Lines," a 32-page ($8^1/_2 \times 11$) illustrated booklet published by The Linde Air Products Company, New York, N. Y.

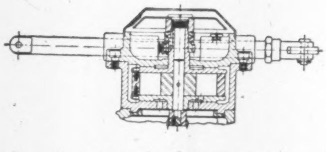
Cam Operated Control for Transitorq

New Departure announce a Cam Operated Control applicable to their Variable Speed Transitorq.

In some applications of the Transitorq, a cam may be placed close enough to the Transitorq Control to operate the cam follower arm shown in the section above.

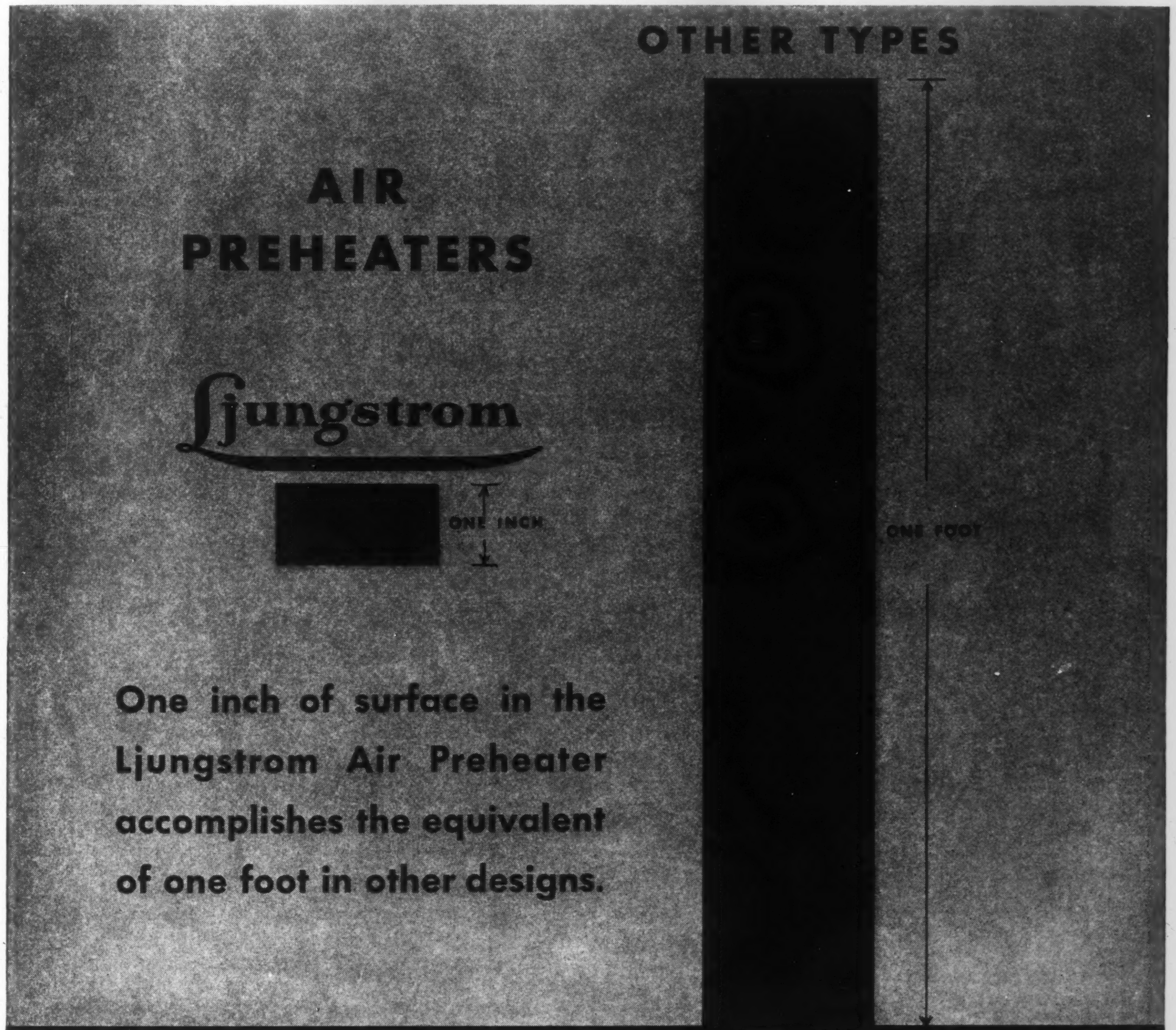


Type DP



A rack cut on the follower arm meshes with a spur gear mounted on the vertical shaft of the Transitorq Control unit. This arm is free to slide back and forth when the Transitorq is not running. When the Transitorq is started or running, that is, when there is oil pressure against the control unit vane, the cam follower is biased by the return spring toward the low speed ratio or against the cam as indicated in the plan view shown above. No other pressure is needed to assure contact of the follower arm with the cam. New Departure Division, General Motors Corp., Bristol, Conn.

Focused Skill Begets Competence


OTHER TYPES
AIR PREHEATERS
Ljungstrom
ONE INCH
ONE FOOT
One inch of surface in the Ljungstrom Air Preheater accomplishes the equivalent of one foot in other designs.

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Elesco has tenaciously held to the precept that its equipment must yield a service so markedly superior . . . that its purchase cannot be questioned by those equipped to judge . . . .

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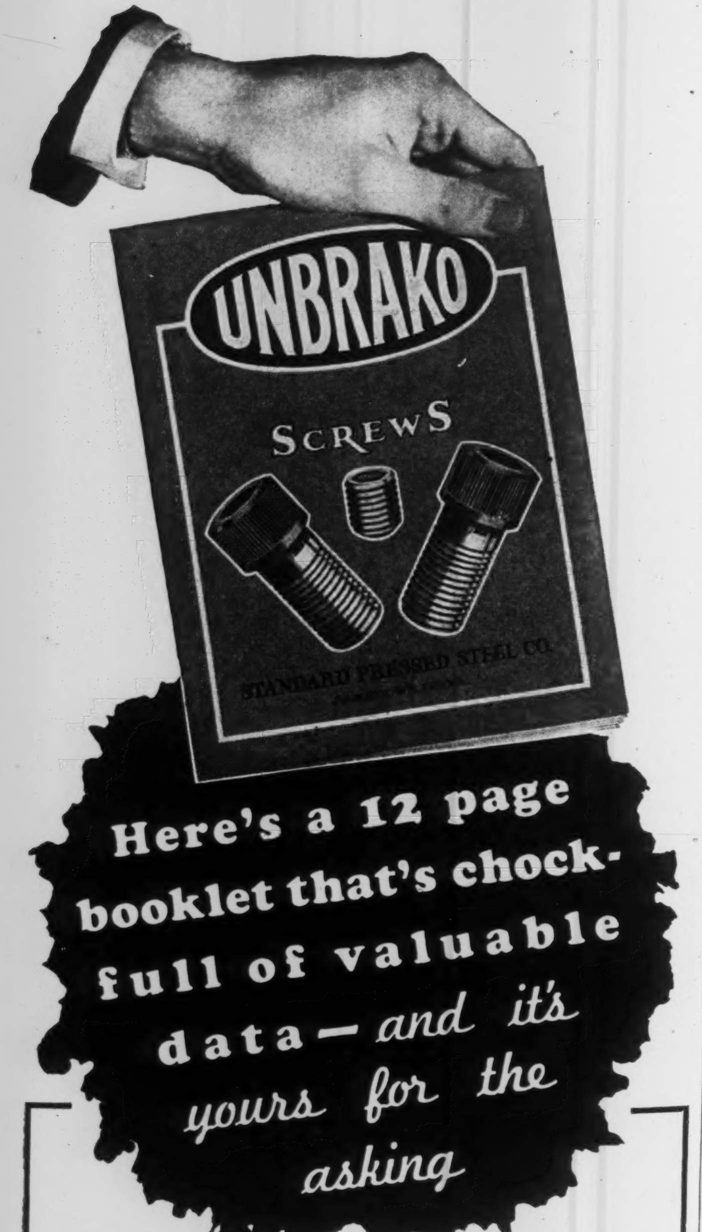
Under Management of THE SUPERHEATER COMPANY
60 East 42nd Street, New York, N. Y.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SCREWS
STANDARD PRESSED STEEL CO.
Here's a 12 page booklet that's chock-full of valuable data—and it's yours for the asking

If you use cap screws or set screws in the manufacture of your product, you should have a copy of this book. It shows the advantages of the knurled construction of "Unbrako" Socket Head Cap Screws and "Unbrako" Hollow Set Screws. It gives sizes, and pictures the many types in the "Unbrako" Line. In fact, it's just loaded with information you should have at your elbow. Fill in the coupon and get your copy.

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The Standards COLUMN

News of Interest to Manufacturers

Freight Elevators

Manufacturers who are contemplating the erection of new buildings or extensive alterations in present structures would do well to familiarize themselves with the fourth edition of the American Standard Safety Code for Elevators (A17). This publication is a set of rules governing safety in the construction, inspection, maintenance, and operation of all types of elevators, dumbwaiters, and escalators.

The committee which has been in charge of the development of this code includes within its membership eminent architects, manufacturers of elevators, large users of elevators, representatives of insurance interests, government officials and consulting engineers.

The first edition of this code was completed by an A.S.M.E. committee and published in 1921. The next year this project was placed under the procedure of the American Standards Association; the sponsorship was assigned to the A.S.M.E., the A.I.A. and the National Bureau of Standards; and the committee was completely reorganized with the cooperation of twenty-two (22) organizations interested in elevator safety.

Following the publication of the second edition in 1925 a subcommittee was formed to make an experimental investigation of the design and construction of safeties, buffers, and other auxiliary devices. The industry subscribed $89,000 toward the expenses of this study and the results of its findings over a period of nine years were included in the third edition published in 1931.

In preparing the present fourth edition the text of the code has been completely revised. The rules dealing with elevators in tall buildings are in harmony with similar provisions of the New York City code. The sections dealing with freight elevators have been enlarged and the field experience with the previous edition has prompted important changes and additions.

From the beginning this code has served as a guide to state and municipal authorities in the drafting of their regulations and has been used by them as a whole or in part. It is intended also for use as a standard reference for safety requirements for the use of elevator manufacturers, architects, and consulting engineers and as a standard of practice for hotels, department stores, office buildings, and other users of elevators through voluntary application.

In the present edition no reference is made to the application of the individual rules to existing installations. This matter is left to the authorities drafting legal regulations who are familiar with the local conditions. A too extensive retroactive application is not advisable in any case. The code contains many rules intended to obviate minor hazards which can be easily eliminated in a new installation, but the change of an existing installation might involve a financial outlay entirely out of proportion to the benefits secured.

An elevator inspector's handbook, which is intended to serve as a guide for the general use of elevator inspectors, has been completed with references to the fourth edition of the code and will also be published this spring.

For further information—address
The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.

"Hold your breath . . . it's working!"

WITH a reasonable amount of tinkering you could get some fairly good reception on the old crystal sets—but who would bother with one today when you can get perfect reception on a modern receiver?

With a reasonable amount of tinkering and maintenance expense you can get fairly good service from old-fashioned pipe lines—but why handicap industrial production or power plant operation when pipe lines welded with WeldELLS have proved that it is possible to eliminate tinkering and maintenance.

It is the first rule of every successful business that no amount of tinkering is "reasonable"—*IF it can be eliminated!*

For the same reason that the crystal set could be justified only until a better way was found, old-fashioned pipe lines are certain to yield to the better way—pipe systems made permanently bottle-tight by welding.

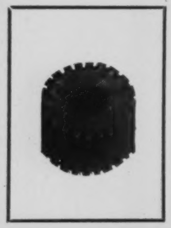
The plants that lead, rather than follow, are recognizing this—by welding with Taylor Forge WeldELLS, the seamless steel welding fittings. WeldELLS are the welding elbows of scientifically engineered design. They are members of the Taylor Forge family of welding fittings; the most complete line of seamless steel welding fittings made.

TAYLOR FORGE

WeldELLS

Seamless Pipe Fittings for Welding

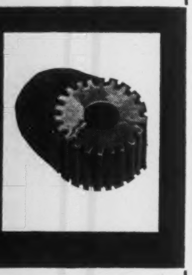
TAYLOR FORGE & PIPE WORKS
General Offices and Works:
P. O. Box 485, Chicago, Ill.
New York Office: 50 Church Street



THIS PART MADE OF MATERIAL "X" HAD SEVERAL DISADVANTAGES

This small gear, used to eliminate noise caused by metal to metal contact, was made formerly from a material that is relatively expensive to fabricate. Possessing *some* of the desired properties, this material fell short in several—notably it had a tendency to crystallize under vibration, wore rapidly, and was seriously affected by oils.

FABRICATED FROM WILMINGTON VULCANIZED FIBRE IT MET EVERY SPECIFICATION!



WILMINGTON FIBRE solved the problem!

Fabricated from this genuine vulcanized fibre, the part possessed *every* property and quality required . . . yet actually cost less to produce, because Wilmington Fibre is very easy to machine.

This case is typical of the improvement and savings that have been made on parts of all sizes and shapes for almost every conceivable purpose. If your product has a part that must provide perfect insulation against current, heat, shock, noise or vibration—and, in addition, must be made from a material of unusually broad physical properties—investigate Wilmington Fibre!

Write today concerning your specific problem . . . or, send for our 32-page treatise on fibre and fibre fabrication. No obligation.

WILMINGTON FIBRE SPECIALTY COMPANY

MANUFACTURERS OF GENUINE VULCANIZED FIBRE

WILMINGTON, DELAWARE

Do YOU know the Answers?

Count 20 points each for the correct answers to the following questions. Can you score 80? Don't look now, but the answers are on page 32.

1. A baseball infield is laid out in the shape of a:
   - Rhombus
   - Square
   - Diamond
   - Helix
2. Of course, you should know that Pelota is:
   - An Indianapolis race driver
   - A French-Basque sport
   - A South American beast of burden
   - A noted Italian statesman
3. You could wear one of these:
   - A South American bolero
   - A Welsh corgi
   - An African bamboula
   - A Spanish serape
4. The name "Kitty Hawk" is associated with:
   - The early days of motion pictures
   - The development of aviation
   - A celebrated divorce case
5. How is absolute cleanliness of Bundyweld Tubing assured?

The Answer to Your Tubing Problem is

BUNDY TUBING

BUNDY TUBING CO. . . . DETROIT

Concerning . . . . A.S.M.E. ACTIVITIES

COMMITTEE ON MEETINGS AND PROGRAM

A new committee was created in 1904 to discharge some of the old activities of the Publication Committee and to take on many functions which the Secretary had previously exercised under the general authority of his office. The name Committee on Meetings was assigned to it. Its duties were to obtain the papers for presentation at meetings and to pass upon their acceptability. It was also made responsible for the program of the meetings, not only as regards the papers and their assignment of place and time but also of details as to visits, excursions and side trips.

In 1912 an important movement was undertaken by the Committee in the appointment of sub-committees covering various phases of mechanical engineering, with the idea of securing increased service through the assistance of specialists in their respective fields. Among the subcommittees were Air Machinery, Cement Manufacture, Fire Protection, Gas Power, Iron and Steel, Machine Shop Practice, Railroads, and Textiles. These subcommittees were gradually reorganized into special Professional Committees and 1920 saw the inauguration of Professional Sections, later designated Professional Divisions.

In 1919 the name of the Committee was changed to Meetings and Program, indicating more accurately the scope of its activities.

The Committee on Meetings and Program has charge of all meetings of the Society which are of national character. This includes the Annual and Semi-Annual Meetings, those meetings previously termed regional meetings but now called Spring and Fall meetings, and the approval of national meetings devoted to a single subject and generally under the direct supervision of a Professional Division.

Whereas during the past two years, as an economy measure, only two "national" meetings have been held each year, the Committee advocates the return as promptly as finances will permit to a four meetings per annum basis. Recently the Committee has provided for a Registration fee for non-members wishing to attend the annual meeting.

Before deciding upon location of a meeting, it is necessary that the members in a given Local Section express keen interest in it. A special form supplied for this purpose when properly filled in, designates a particular group of members who are willing to undertake the responsibility for conducting the local arrangements, outlines the plants (and their products) available for visits, and gives statistics regarding the hotel situation. The petition is considered in turn by the Committees on Local Sections, Professional Divisions, and finally by the Committee on Meetings and Program. It is then forwarded with the joint recommendation of the three committees to Council for approval. Similar procedure is followed in the case of meetings of Professional Divisions in a locality where a Local Section is established.

When a national meeting has been approved all Professional Divisions are given opportunity to indicate the degree to which they will wish to participate, as to number of technical sessions desired and specific topics of papers which may be presented. Their advice is also sought regarding plants which they would like to have made available for inspection in order that opportunity may be given to witness the engineering performance of apparatus described in the technical sessions where it is possible to accomplish this.

In the matter of meetings devoted to a specific Professional Division, or two or more Divisions joining in a planned program, it is customary for the Divisions to take the initiative, decide upon the location for the meeting and approach the Local Section for its cooperation.

The Committee on Meetings and Program develops its plans in accordance with the size of the budget which is made available by Council. Obviously its policy is to seek the largest possible budget consistent with the income of the Society in order to make available to the membership frequent opportunity for attendance at meetings. These meetings not only provide social contacts in the extension of fellowship within the Society but give opportunity for the discussion of current engineering development, and likewise provide the basic material for the publications of the Society.

The Committee on Meetings and Program will appreciate the interest and cooperation of the membership and suggestions as to topics, speakers, plants where new engineering apparatus may be inspected, or ways to make the meetings of greater interest and value.

For further information—address

The American Society of Mechanical Engineers
29 W. 39th St., New York, N. Y.

MOLY trains Diesels down to "fighting weight"

Molybdenum irons have played an essential part in the development and performance of modern, light, high-speed Diesel engines.

One key manufacturer has standardized on Moly iron for a number of vital parts—including cylinder blocks, liners and exhaust manifolds—because of its outstanding ability to meet the strict requirements.

The toughness of Moly iron; its resistance to wear and elevated temperatures; and its resistance to the corrosive action of hot exhaust gases—all contribute to engine efficiency. Light sections are permissible, and the necessary close tolerances are permanently maintained. The comparative ease with which Moly iron can be machined is also an important factor.

Our technical book, "Molybdenum," contains practical data on Moly irons and steels. It will be sent on request—as will also our monthly news-sheet, "The Moly Matrix." Be free to consult our laboratory on special ferrous problems. Climax Molybdenum Company, 500 Fifth Avenue, New York City.

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New Fairbanks-Morse Pump Bulletin

Characteristics and applications of power pumps are discussed in detail in Bulletin 6160 covering duplex power pumps, just issued by Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill. Their design and operating principles make them more suitable than pumps of another type for certain conditions and requirements.

Fairbanks-Morse duplex power pumps, with self-oiling power end and valve deck type fluid end, are offered in two complete lines: Standard General Service and Heavy Duty. Standard General Service pumps are available in sizes of $2^1/_2$ to 3 in. by 4 in. and $2^1/_2$ to 6 in. by 6 in., with capacities to 215 gal. per min. at pressures to 250 lb. Heavy Duty pumps, with sizes of $2^1/_2$ to $3^1/_2$ in. by 4 in. and 3 to 4 in. by 6 in., have capacities to 93 gal. per min. at pressures to 500 lb.

F-M power pumps are available as basic pumps, for belt drive with tight and loose pulleys, chain driven by top-mounted motor, with tandem-mounted motor and Flex-Mor V belt drive, and with F-M type Z gasoline engine. Both the power and pumping units for each of these combinations are manufactured by Fairbanks, Morse & Co., affording undivided responsibility for operation. Pumps can be adapted to various service demands by changing the size of pistons and removable liners, and using special valve services, piston packings and construction materials.

Grindability of Coals

Tables of grindabilities and analyses of many of the coals mined in the United States, Canada, and other countries are contained in this new 32 page bulletin recently released by The Babcock & Wilcox Company. The grindabilities were determined by the A.S.T.M. Tentative Method D-409-35-T. Anyone concerned with the burning of pulverized coal should find these tables of interest. Copies of this publication may be obtained by writing to The Babcock & Wilcox Company, 85 Liberty St., New York, N. Y.

Stearns-Magnetic Issues New Catalog

Magnetic Hand Book is the title of a new loose-leaf manual issued by the Stearns Magnetic Mfg. Co., 614 South 29th Street, Milwaukee, Wis., for distribution to its sales organization. It comprises 170 pages, 9 × 12-inch format, with rich fabricoid cover. This new book was compiled in answer to the demand for a standardized catalog containing technical data, illustrations and description of the various phases of magnetic engineering and is a comprehensive survey of the subject.

In the section devoted to magnetic separation, the separation, concentration and purification of ores, minerals, sands, food stuffs, grain and numerous other classes of material, pottery and porcelain slip, pulverized clay; protection of crushers, grinders and pulverizers, and the different processes of wet and dry magnetic treatment are a few of the subjects covered in this Magnetic Hand Book. Also described are the numerous types of friction devices employed in power transmission. The Stearns company has pioneered more equipment of this kind than any other manufacturer in the business, according to its claim. Magnetic clutches, brakes and clutch-brake units; duplex clutches and other combinations are shown in text, drawings and illustrations. Methods of suspended magnet application also are included in this new Stearns hand book.

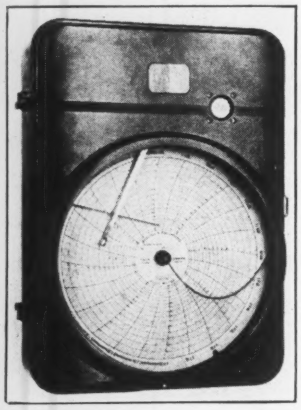
New Goetze Booklet

Goetze Gasket & Packing Co., 34 Allen Ave., New Brunswick, N. J., has just issued a new booklet entitled "Fifty Years of Experience" covering the subject of gaskets and packing.

This booklet is unique in its description of a little-known industry—the design and manufacture of modern gaskets for innumerable standard and special requirements of sealing joints against temperature, pressure and corrosion.

Bristol Co. Introduces New Line of Electric Flow Meters

The Bristol Company, 21 Bridge St., Waterbury, Conn., announces addition of a complete line of Electric Flow Meters for steam, liquids, and gases to its line of mechanical Flow Meters. These Flow Meters operate on the Bristol Metameter principle of telemetering, which the company has used for several years in instruments to transmit readings of pressure, liquid level, temperature, and motion from the point of measurement to a distant point where they are recorded or indicated on a dial.



Bristol's Electric Flow Meters can be furnished for recording, integrating, and indicating flow. The readings are transmitted over a simple two-wire circuit, telephone circuits included, which does not enter into the calibration of the instruments. Bristol Meter Body is employed to measure the differential across an orifice. High accuracy is obtained at all points on the scale.

Both the transmitter and the receiver are equipped with moisture-, fume-, and dust-proof aluminum alloy cases. Conduit openings are provided so that the instrument may be used with modern wiring systems.

City of Cleveland Buys Three Stowe Stokers

Cleveland, Ohio.—Announcement has been made by the Board of Control, City of Cleveland, Ohio, of an award reported at $78,800.00, to the Stowe Stoker Division of The Johnston & Jennings Company, 889 Addison Rd., Cleveland, Ohio, for three (3) Stowe Stokers to replace a like number of Underfeed Stokers in the City's Municipal Light Plant. Increased demands on this plant have necessitated obtaining a greater steam output. The unusual features of the Stowe Stoker make this possible without the purchase of new boilers or material changes in furnace design. Under each of the 1400 H. P. Connelly Boilers will be installed a Stowe Stoker of 350 square feet of active grate area. With the Stowe compensating feed principle giving a level fuel bed, these boilers will be driven to 300% of rating. When this installation is completed added economy will be obtained by the use of less costly fuel mined within the state of Ohio, which carries considerably less freight charge than the more expensive coals from outside the State that were required by the older type of equipment. These improvements in the Municipal Light Plant are being made under the direction of Frank O. Wallene, Director of Utilities, and L. A. Quayle, Chief Engineer.

New James Speed Reducer Literature

New publications are announced by the D. O. James Co., 1114 West Monroe St., Chicago, Ill., covering the subject of right angle speed reducers with HP ratings, dimensions and very complete description.

Bulletin No. 11 covers right angle spiral bevel gear speed reducers with ratios of 1:1 up to 6:1.

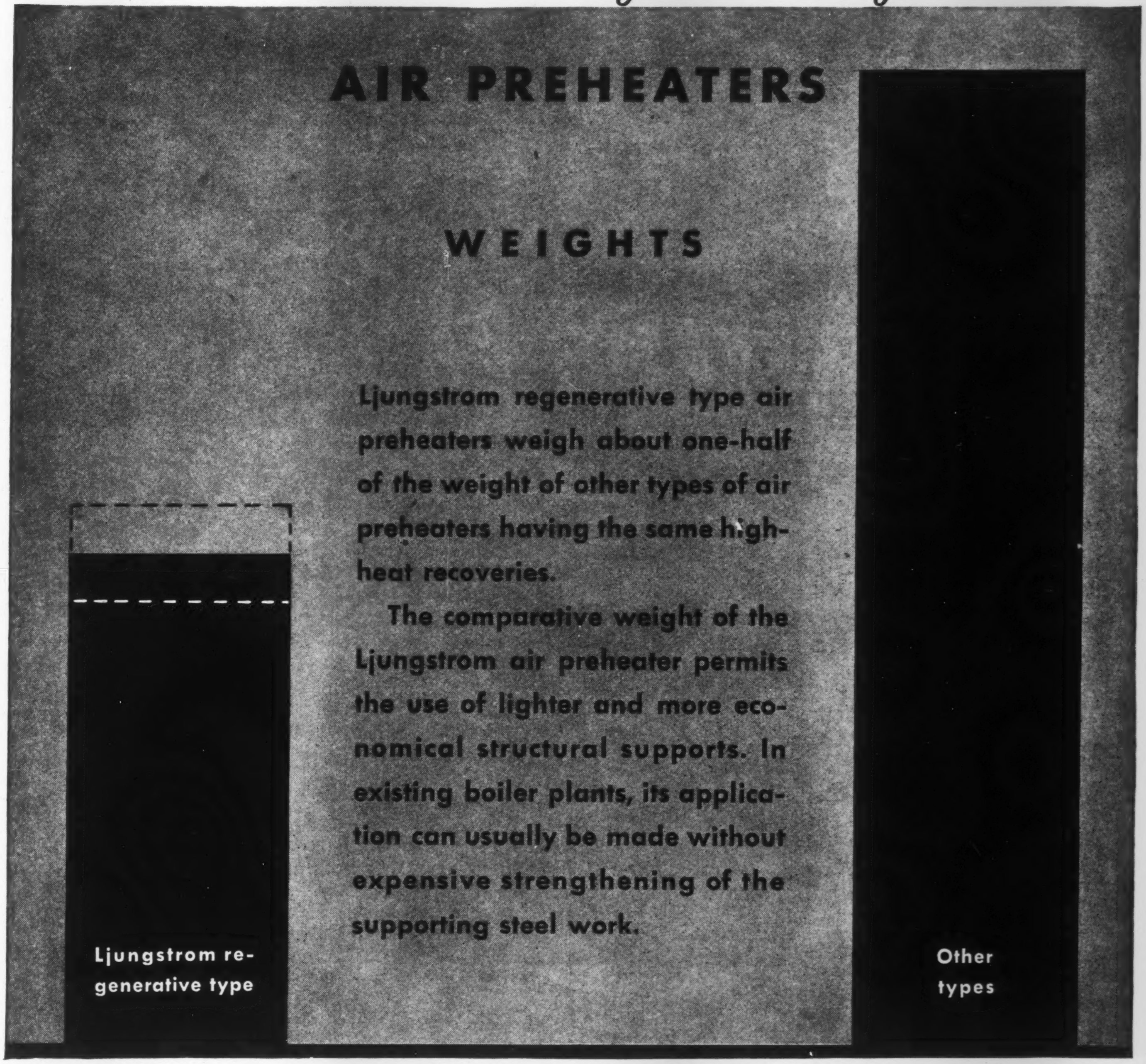
Bulletin No. 16 covers right angle spiral bevel continuous tooth herringbone reducers with ratios of 6:1 up to 45:1.

Catalog No. 141 covers right angle spiral bevel spur gear speed reducers with ratios of 8:1 up to 1200:1.

New De Laval Pump Catalog

Motor-Mounted pumps are described in a catalog issued by the De Laval Steam Turbine Co., Trenton, N. J. This term is used to designate a unit consisting of a centrifugal pump mounted directly upon the frame of an electric motor to form a compact, self-aligned unit with only one shaft and two bearings. The unit does not require a special foundation or sub-base, but can be attached to whatever support is most convenient, such as column, floor, wall or ceiling, and in any position, as upside down or with the shaft vertical. Also, it may be placed upon a hand truck or suspended from a sling, for portable use. Dimensions and other details are given for pumps of capacities from 5 to 1200 gallons per minute and for heads from 10 to 230 ft., and also pipe friction tables and instructions for selecting and installing pump units. The motor may be of the open, splash-proof, totally enclosed, or explosion-proof type, for direct or alternating current.

Focused Skill Begets Competence



AIR PREHEATERS

WEIGHTS

Ljungstrom regenerative type air preheaters weigh about one-half of the weight of other types of air preheaters having the same high-heat recoveries.

The comparative weight of the Ljungstrom air preheater permits the use of lighter and more economical structural supports. In existing boiler plants, its application can usually be made without expensive strengthening of the supporting steel work.

Economy of weight is as fundamental in good design as efficiency in operation. If both are not present, it is not sound engineering.

THE AIR PREHEATER CORPORATION

Ljungstrom AIR PREHEATER

Under Management of THE SUPERHEATER COMPANY
60 East 42nd Street, New York, N. Y.

A-1066

INDUSTRY'S HERITAGE *from* MOTORDOM

- Industrial Engineers and Designers specify "Clevelands" for diversified and often difficult applications, because of this Company's notably successful record during a quarter-century.

"Cleveland" was organized in 1912 to build worm gears for the pioneering automotive industry, where Cleveland Worm Gear Drives were used in comparatively large quantity for rear axles.

The Company also pioneered almost 20 years ago, by introducing the automotive type of worm gear to meet the growing demand for industrial speed reducers. For 25 years, "Cleveland" has remained largest in the industry manufacturing high precision worm gearing *exclusively.*

In recent times, the automotive industry has again become a great market—many hundreds of "Clevelands" drive conveyors, furnaces, machinery, foundry equipment, ventilating fans, assembly line feeders and more than 40 other kinds of its plant equipment.

Whatever the nature of your own speed reducer applications, you doubtless will find sound help in consultation with a "Cleveland" Engineer. A representative from a nearby District Office will call at your convenience. The Cleveland Worm & Gear Company, 3264 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication.

CLEVELAND *Worm Gear Drives*

The Standards COLUMN

News of Interest to Manufacturers

Steel Welding-Neck Flanges

It can now be reported that the proposed American Standard for Steel Welding-Neck Flanges has been unanimously approved by letter ballot vote of the technical committee which has been at work on it since February, 1931.

The demand for a national standard for this type of steel flange was presented by a representative of the American Petroleum Institute's Committee on the Standardization of Refinery Equipment to the Sectional Committee on the Standardization of Pipe Flanges and Fittings (ASA B16) in December, 1930. A subgroup was immediately appointed to develop the preliminary proposal.

In the early stages of its work the subgroup studied several proposed series of standard dimensions for welding-neck flanges in use by interested firms and organizations. The first draft of the proposed standard was completed in the fall of 1932 and the second, revised draft was distributed generally to industry for criticism and comment in May, 1933.

It should be understood, of course, that the facing dimensions called for in this new proposal are identical with those of the present American Standard for screwed or lapped flanges (B16e–1932) so that complete interchangeability is assured.

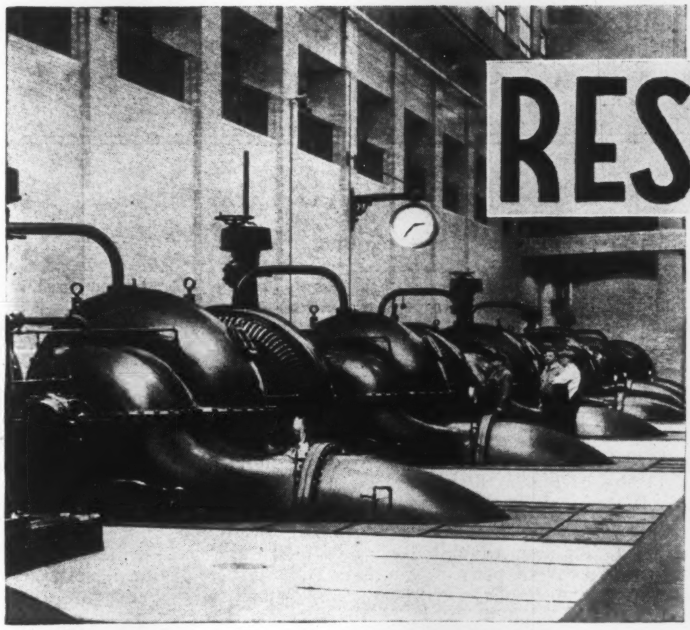
The replies received as a result of the general distribution were carefully reviewed and a third draft dated April, 1936, was prepared. This was the one on which the vote of the committee was obtained. The difficulty in establishing certain details relative to the dimensions of the 1500 lb welding-neck flange and the standard design for the chamfer delayed the release of the proposed standard by the subgroup.

COMMITTEE OFFICERS AND MEMBERS OF SUBGROUP

Collins P. Bliss, *Chairman*, Sectional Committee B16, Consulting Engineer, New York, N. Y.
John J. Harman, *Secretary*, Sectional Committee B16, General Secretary, Manufacturers Standardization Society of the Valve and Fittings Industry, New York, N. Y.
Leslie D. Burritt, *Chairman*, Subgroup, Engineer, General Engineering Department, Standard Oil Development Co., Elizabeth, N. J.
Henry E. Haller, President, National Valve and Manufacturing Co., Pittsburgh, Pa.
John S. Hess, Chief Engineer, Refineries, Sinclair Refining Co., New York, N. Y.
Abbott L. Penniman, Jr., Superintendent, Steam Station, Consolidated Gas & Electric Light & Power Co., Baltimore, Md.
J. Hall Taylor, President, Taylor Forge and Pipe Works, Chicago, Ill.
George W. Watts, Chief Engineer, Standard Oil Company of Indiana, Whiting, Ind.
John H. Zink, President, General Manager, Heat and Power Corporation, Baltimore, Md.

For further information—address

The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.



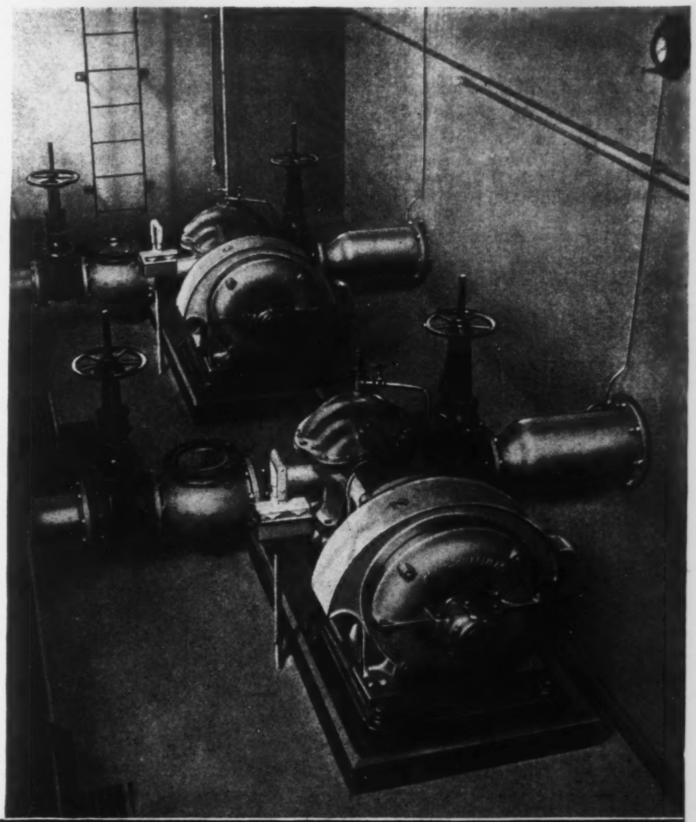
RESPONSIBILITY *Undivided*

Allis-Chalmers 54" x 48" Centrifugal Sewage Pumps, driven by Allis-Chalmers 2000 hp synchronous motors.

THESE ALLIS-CHALMERS pumping units are giving the utmost in actual pumping value per dollar of actual cost.

And like every pumping unit manufactured by Allis-Chalmers they were designed for the highest possible efficiency—and what's more, selected to operate at their maximum efficiency under the customers' own conditions.

Allis-Chalmers is the only company building complete pumping units, consisting of the centrifugal pump and any type of drive—*and that means there is no divided responsibility . . . there is no lack of coordination between pump and drive.*



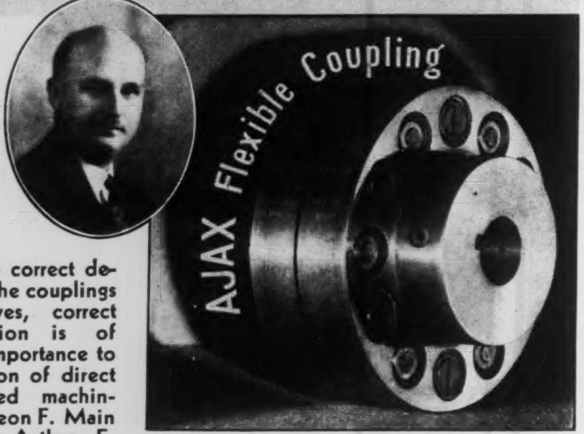
Three Allis-Chalmers Centrifugal Pump Units for water supply, each rated 3500 gpm. 140 ft. head, and driven by an Allis-Chalmers 150 hp, drip proof, cage type induction motor.

CENTRIFUGAL PUMPS

ALLIS-CHALMERS

MILWAUKEE WISCONSIN

In Buffalo, **PLANT MEN THINK OF LEON F. MAIN OF ARTHUR E. JONES CO. WHEN THEY NEED COUPLINGS......**



Next to correct design of the couplings themselves, correct application is of prime importance to protection of direct connected machinery. Leon F. Main of the Arthur E. Jones Co., Buffalo, N. Y., is an authority on couplings and their installation. Positive Drive . . . Resilient Flexibility . . . Protection Against Misalignment . . . Free End Float . . . Long Life Dependability . . . you get them ALL with Ajax Flexible Couplings. Call in your Ajax man or write for Ajax Data Book.

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STOPPING LEAKS at FLANGES without disassembling the joint

PICKING out weak gasket spots and forcing Smooth-On No. 1 into their place, or if the leak is at a bolt, putting Smooth-On No. 1 under the bolt head and nut and tightening will often make an equally effective seal.

Removing the nearest bolt and forcing Smooth-On No. 3 into the packing space is also excellent procedure. This may be done by closing one side temporarily with a wooden plug (Fig. 1) and forcing the Smooth-On into the other with a hammer and close-fitting rod—or the Smooth-On may be filled in through a temporary stud drilled through the center to take a smaller rod, and crosswise with holes leading into the packing space (Fig. 2).

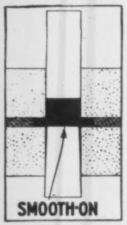

Fig. 1

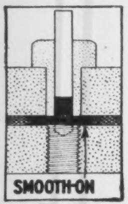

Fig. 2

SMOOTH-ON HANDBOOK
HELPFUL IDEAS for ENGINEERS

The Smooth-On Handbook gives instructions for many other simple, effective and time saving repairs. *Mail the coupon for a free copy, and get Smooth-On in 1 or 5-lb. can or larger pail from your supply house or from us.*

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Concerning . . . .
A.S.M.E. ACTIVITIES

COMMITTEE ON PUBLICATIONS

Last month this column was devoted to the work of the Committee on Meetings and Program of The American Society of Mechanical Engineers. How the papers presented at Society Meetings under the sponsorship of this committee and other Society agencies that contribute to the technical literature of the mechanical engineering profession are handled under the supervision of the Committee on Publications is to be told in this month's column.

One of the first acts of the Council of The American Society of Mechanical Engineers was the appointment of a Committee on Publications. The earliest committee served only until November, 1880, but during its brief existence it prepared for publication and distributed 1500 copies of the first Catalogue, which later became the "Year Book" and in 1928 the Membership List, which is still published today as one of the activities of the Committee on Publications.

With that first Annual Meeting of 1880 came the presentation of papers worthy of permanent preservation in printed form, and the Committee on Publications therefore undertook the preparation of the Transactions. Up to 1926 the Transactions appeared as an annual volume comprising the papers of most permanent value. At that time the growth of the Society's Professional Divisions had so increased the number of papers available for publication that a new scheme of more frequent publication was put into effect. Up to 1934, therefore, the papers of the several divisions were issued from time to time throughout the year in sections divided as to subject matter in accordance with the special interests of the divisions. In 1934 all sections were combined in a monthly periodical, Transactions, four issues of which were devoted each year to the papers of the Applied Mechanics Division and called "Applied Mechanics Journal." The "Society Record," including indexes, reports, committee personnel, and memorials to deceased members, was issued occasionally as part of the Transactions. During all these years since 1926 the numerous sections of Transactions were, and are today, bound together in an annual volume, thus retaining the permanent feature of earlier issues.

In order to provide advance copies of papers prepared for presentation and for the publication of other Society material "Proceedings" was instituted in 1883. In 1908 this was enlarged as to scope and called the "Journal," and in 1920, after a study had convinced the Society that further improvements and enlargement were indicated, "Mechanical Engineering" became its name.

By 1921 it became evident that Society news should be separated from the technical papers and other general features of Mechanical Engineering, and hence a semi-monthly publication "The A.S.M.E. News" was inaugurated. Business conditions in 1933 forced the amalgamation of the News with "Mechanical Engineering," where it still appears.

As an outgrowth of "Mechanical Engineering" and to meet a need for condensed statements of the products of manufacturers of mechanical engineering equipment, the Committee on Publications instituted an annual volume known today as "Mechanical Catalog."

Other activities under the supervision of the Committee are the publication of codes and standards developed by the Society's technical committees, biographies of eminent members of the Society, and miscellaneous books and pamphlets resulting from work carried on by the Society and its numerous committees.

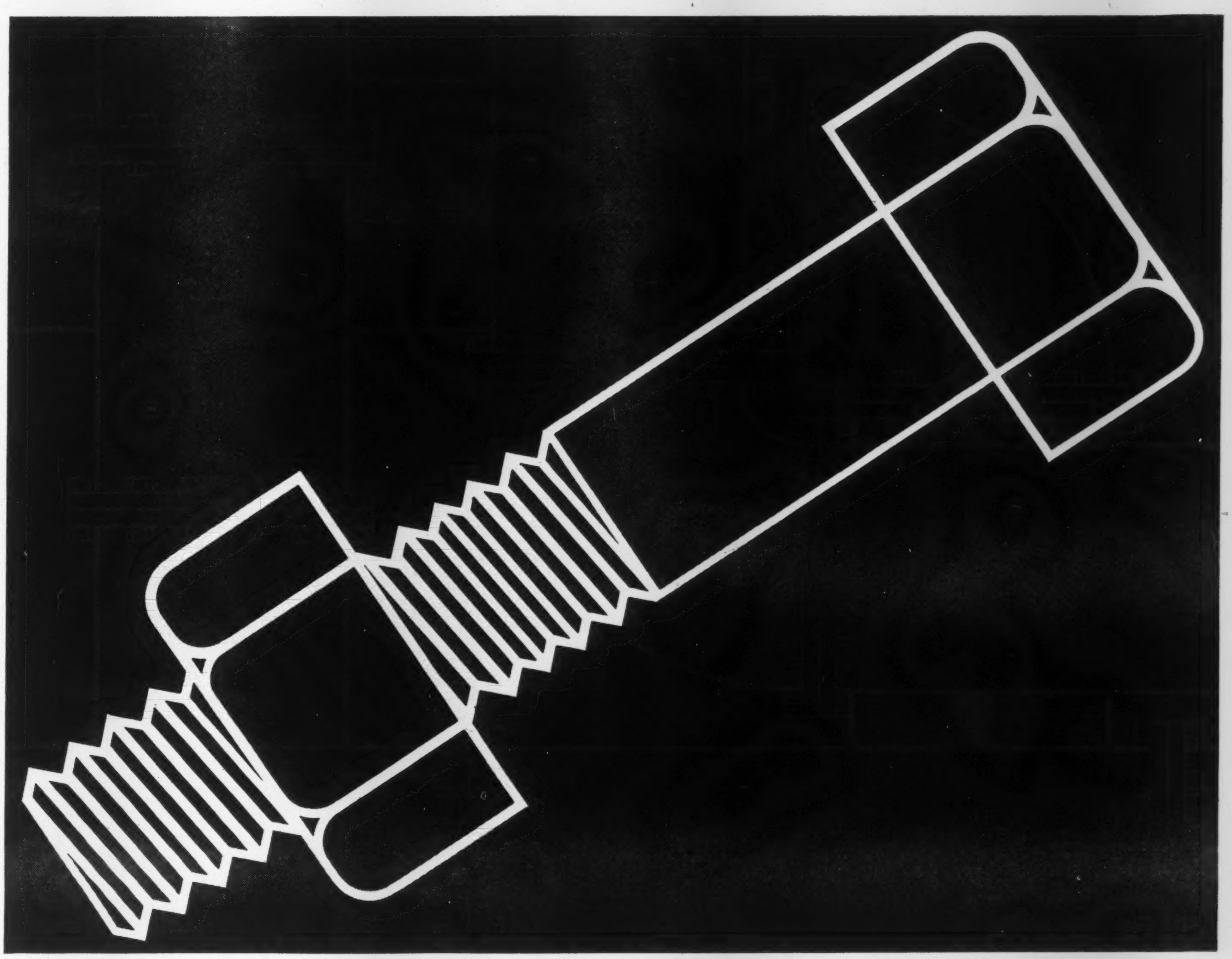
This extensive publication work of the Society is administered by a committee of five members, one of whom is replaced every year by presidential appointment. Recently, advisory members have been added to the committee. At present there are six of these, four located in geographically different sections of the country and two drawn from the ranks of junior members.

Papers for publication are received by the Committee on Publications, after review and with recommendation to publish, from the numerous divisions and committees with which they originate. From these the Committee on Publications selects those it can publish and assigns each paper to "Mechanical Engineering" or Transactions.

In addition to papers officially received in this manner the Committee receives others directly from the Local Sections and from individual contributors. These are reviewed and, if approved by the Committee, are published in "Mechanical Engineering."

For further information—address

The American Society of Mechanical Engineers
29 W. 39th St., New York, N. Y.



"Take care of the pennies . . ."

ONE bolt is small, and comparatively inexpensive—either to buy or to make. But—bolts "in the mass" can easily represent a very considerable outlay. The saving of even a small fraction of a cent in the production cost may come to a substantial sum in the aggregate.

For example: One concern has standardized on Chrome-Moly (SAE 4140) bolts because they are easier to machine—resulting in savings on both tool expense and machining time. In addition, their improved physical properties assure better service performance.

Moly steels are cutting production costs throughout industry because they are more economical to fabricate—whether the process be heat-treating, forging, carburizing, or machining. . . . They also impart to finished products higher quality, resulting in better service.

Our free technical book, "Molybdenum," will prove useful to engineers and production heads interested in cost cutting and product improvement. Our monthly news-sheet, "The Moly Matrix," keeps readers informed on Moly developments. Consult our laboratory when ferrous problems get tough. Climax Molybdenum Company, 500 Fifth Avenue, New York City.

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Announcements received from the advertisers in MECHANICAL ENGINEERING and the MECHANICAL CATALOG

Larger Size Hancock Valves

The Hancock Valve Division of the Consolidated Ashcroft Hancock Company of Bridgeport, Connecticut, announce the completion of the $1^1/_4$", $1^1/_2$" and 2" sizes in globe and angle patterns of their new line of bronze Hancock Valves. Sizes 1" and smaller were put on the market a year ago and the makers say they have been so successful that it was imperative to finish the line.

This new line of Hancock Valves is distinguished by the exceptionally hard stainless steel seats and discs with which they are equipped. The trim in these Valves is heat treated to a hardness of 500 Brinell and then machined on a Diamond Boring Machine (said to be the only one of its kind). The makers claim that this remarkable hardness enables these Valves to smash paper clips, nails, pipe turnings, boiler scale and sand without leaving a trace of a mark on either the Valve seats or discs.

The illustration shows a steel nail which the makers state was crushed between the seat and disc of the 2" Valve pictured. It is further claimed that this unusual hardness gives these new Valves added resistance to wire drawing and steam cutting and thus lowers maintenance costs.

Other advanced features of design and metallurgy are fully explained in a new bulletin which will be furnished on request.

The Science and Use of Photoelastic Methods Advanced by Polaroid

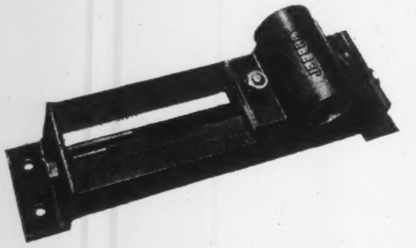
The problem of stress determination and distribution is one of the most interesting and most important in the field of applied science. Elementary engineering theory in material testing is a theory of average stresses rather than exact stress distribution and as such, may often lead to incorrect conclusions; e. g.: axial loads do not necessarily produce uniform stress distribution; and the dimensions of a part are not necessarily an indication of its strength. Engineering practice frequently resorts to the actual testing of machine parts or a small model of them, to the point of breakdown or failure and from data thus collected, infers averages or approximation of stresses which can be at considerable variance from actual conditions.

Whereas photoelasticity also resorts to experiment by testing of parts, however this is done with transparent models where the engineer can actually see the stresses and definitely measure them by simple means. The photoelastic method is based upon the temporary double refraction induced in a beam of polarized light when passing through a stressed isotropic transparent material such as glass, celluloid, bakelite, marblette and some other plastics.

The apparatus used in the past has been rather complex and inconvenient for use. The source of polarized light was the Nicol prism which, because of its natural limitations, made it necessary to use a lens system in a long apparatus. Such a set-up has its distinct disadvantages. With the development of Polaroid, which is available in large apertures, and through the use of large aperture quarter wave plates, these disadvantages are eliminated resulting in a compact instrument of short length and of relatively low cost.

The Polarizing Instrument Company, 8 West 40th St., New York, N. Y., have brought out a photoelastic polariscope of very simple design using large apertures of both Polaroid and of quarter wave plates. The development of this instrument should bring about greater activity in the use of photoelastic methods. To encourage this increased interest and use, this company is establishing a service whereby all papers and other releases which relate to the field of photoelasticity, will be reprinted and sent out, free of any cost, to those interested in this work who have their names on file with them. They also request that authors of papers send copies of such papers to them and they will be reprinted and mailed out.

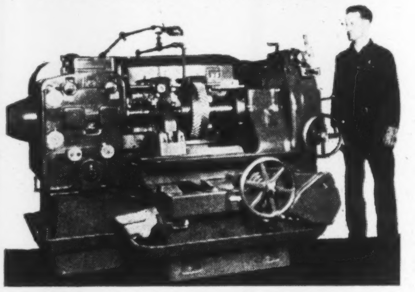
Jeffrey Protected Screen Takeup



A new protected screw takeup for conveyors and elevators is announced by the Jeffrey Manufacturing Company, 904–99 Fourth Street, Columbus, Ohio. The adjusting screw is protected from dust and dirt by an inverted U-shaped shield which extends from end to end of the takeup frame. The sliding base casting, which carries an adjustment nut of bronze, is cored out in such a way that it slides freely over the shield, thus relieving the shield of any function other than of protecting the screw. As the adjusting screw does not travel but remains inside the frame, it is protected from damage at all times. The screw is also protected from operating strains and shocks, in fact relieved of all load; for, after adjustment, the bearing is rigidly clamped to the rugged steel frame.

New Gear Generating Machine

The new Farrel-Sykes 2-C Gear Generating Machine recently introduced by Farrel-Birmingham Company, Inc., Buffalo, N. Y., is specially designed to meet the most exacting demands for high-precision gearing, coupled with high-speed production. A single operator can attend from two to four machines. Frequently change of work takes only a few seconds, and the usual set-up time is said to be less than an hour. The automatic infeed mechanism is adjustable to take from one to seven cuts. Changes in the depth feed are made without special equipment. Except for mounting the work and taking it off, the new Farrel-Sykes 2-C Gear Generating Machine is entirely automatic. In addition, the manufacturers state it offers great durability, uninterrupted performance and low maintenance cost.



It is equally suitable for tool room or general jobbing work or line production. It will cut every type of gear connecting parallel axes; machine cylindrical surfaces on shafts or pistons; cut parallel and tapered spline shafts, two members of a cluster gear or many gang-mounted gears simultaneously.

According to the manufacturers, this new Farrel-Sykes 2-C machine will execute perfectly such difficult assignments as cutting double helical gears for aeroplane power transmission, or special increasing gears for driving superchargers. Its maximum cutting speed is 800 strokes per minute. Weighing 13,900 pounds, it occupies only 111" x 87" of floor space.

It is claimed that owing to special hardening of its sliding surfaces this new machine will operate 30,000 hours without wearing enough to appreciably affect the mechanism. Speed and feed controls are on the front. The speed and feed change-speed gear box is in one unit. All high-speed moving parts are forced lubricated, and slide-ways are covered to keep grit out of the sliding surfaces.

Full information on the Sykes 2-C Gear Generating Machine can be had from Farrel-Birmingham Company, Inc., 348 Vulcan Street, Buffalo, N. Y.

Latest Lunkenheimer Guide

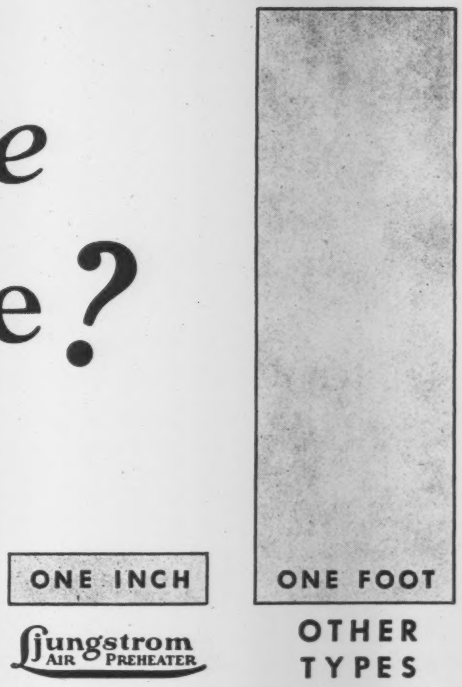
The Lunkenheimer Co., Cincinnati, Ohio, announce their latest Guide which is just off the press.

The Guide is an illustrated sixteen page ready reference for selecting valves, boiler mountings and lubricating devices in which products are grouped by pressure, type and use. It is widely used by buyers and specifiers of these products.

Pressure Regulator Selector Chart

Davis Regulator Co., 2547 S. Washtenaw Ave., Chicago, offers a novel chart designed to enable anyone to make a quick and accurate selection of the proper type of pressure reducing valve to use for any given kind of service on steam, gas, air, oil, or water.

Why *Waste* Expensive Space?



One inch of surface in Ljungstrom air preheater accomplishes the equivalent of one foot in other designs.

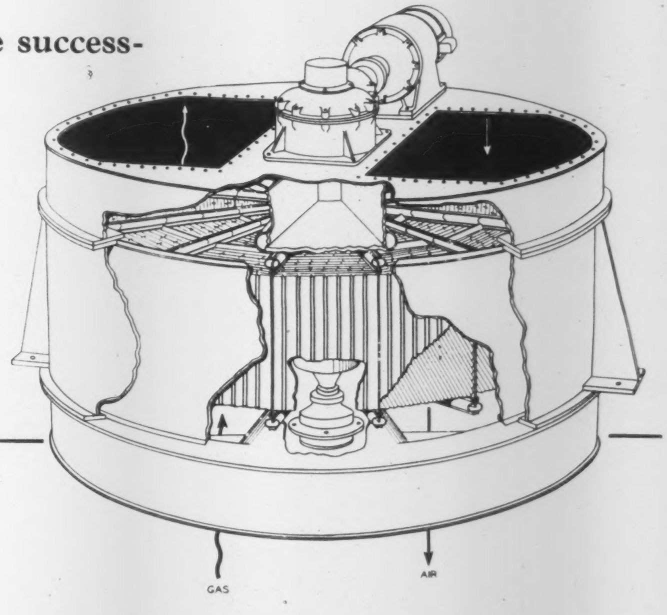
1 Space is frequently at a premium in a steam generating plant.

2 In a plant of high capacity, large surfaces are necessary for the air preheater.

3 With the exclusive Ljungstrom air preheater design, however, large surfaces are concentrated within a comparatively small area and naturally require substantially less space than would otherwise be possible.

4 Ljungstrom air preheaters save space successfully.

Ljungström



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Under Management of THE SUPERHEATER COMPANY
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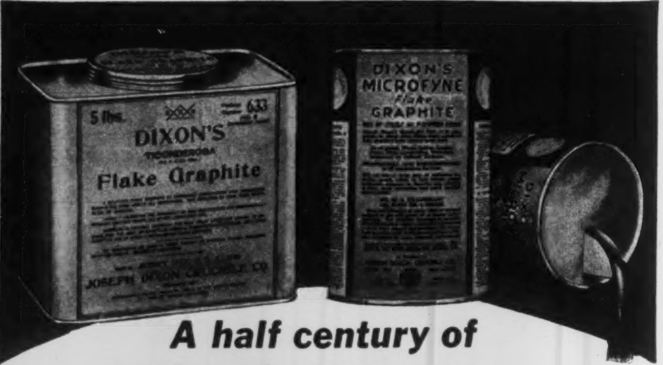

A half century of engineering progress . . . and

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Power plants of fifty years ago welcomed Dixon's Ticonderoga Flake Lubricating Graphite. It became indispensable for lubrication, for coating gaskets, packing and countless other uses. The qualities inherent in Dixon's Ticonderoga Flake Lubricating Graphite need no stronger endorsement than the fact that, with all the changes in power equipment, this fine old Dixon product still holds its place and the red can is as familiar to engineers today as it was a half century ago.

Dixon's Ticonderoga Flake Lubricating Graphite No. 1 has large unctuous, Lustrous flakes of the highest grade natural flake graphite. In size No. 2, the flakes are finely powdered.

DIXON'S MICROFYNE FLAKE GRAPHITE—Processed to microscopic sub-division in particle size. Adapted to applications requiring highest purity in smallest particle size. Write for booklet C-100.

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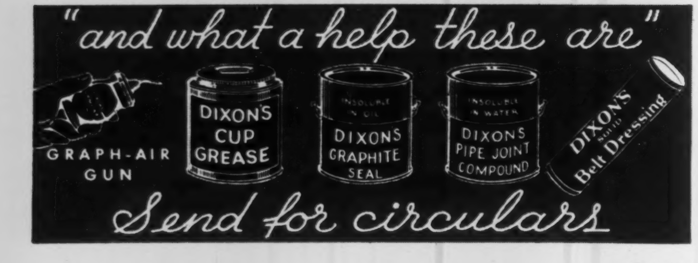


6355

The Research COLUMN

News of Interest to Manufacturers

Theory and Application of Fluid Meters

Recent developments in the application of fluid meters and improvements in the present day meters themselves has prompted the preparation of a new, fourth edition, of Part I of the report of the A.S.M.E. Special Research Committee on Fluid Meters. This pamphlet will become available early in April.

The text of this edition has been completely rewritten and 90 per cent of the illustrations have been changed. A radical change has been made also in the arrangement of the material. The development of the subject has been subdivided into three sections—A, B, and C, which may be briefly described as follows: In *Section A*, the classification and nomenclature of fluid meters, as used throughout the reports of this committee, are given, together with the definitions of special terms and other general information. In *Section B*, the theory of fluid measurements is presented. In most cases, the assumptions made and the steps taken to develop practical working equations from the theoretical relations are set forth. *Section C* contains figures and tables for use in solving practical fluid-measurement problems, and their proper use is illustrated with examples.

Since the third edition of this report was published in 1930, two important researches in this field have been undertaken by the committee. The first of these was to determine the types of orifices to be used for metering gases, and other fluids, and to determine the constants to be used in calculating the flow through these orifices. This research was sponsored jointly by the American Gas Association and the A.S.M.E. The second is the research on flow nozzles which is still in progress at the National Bureau of Standards.

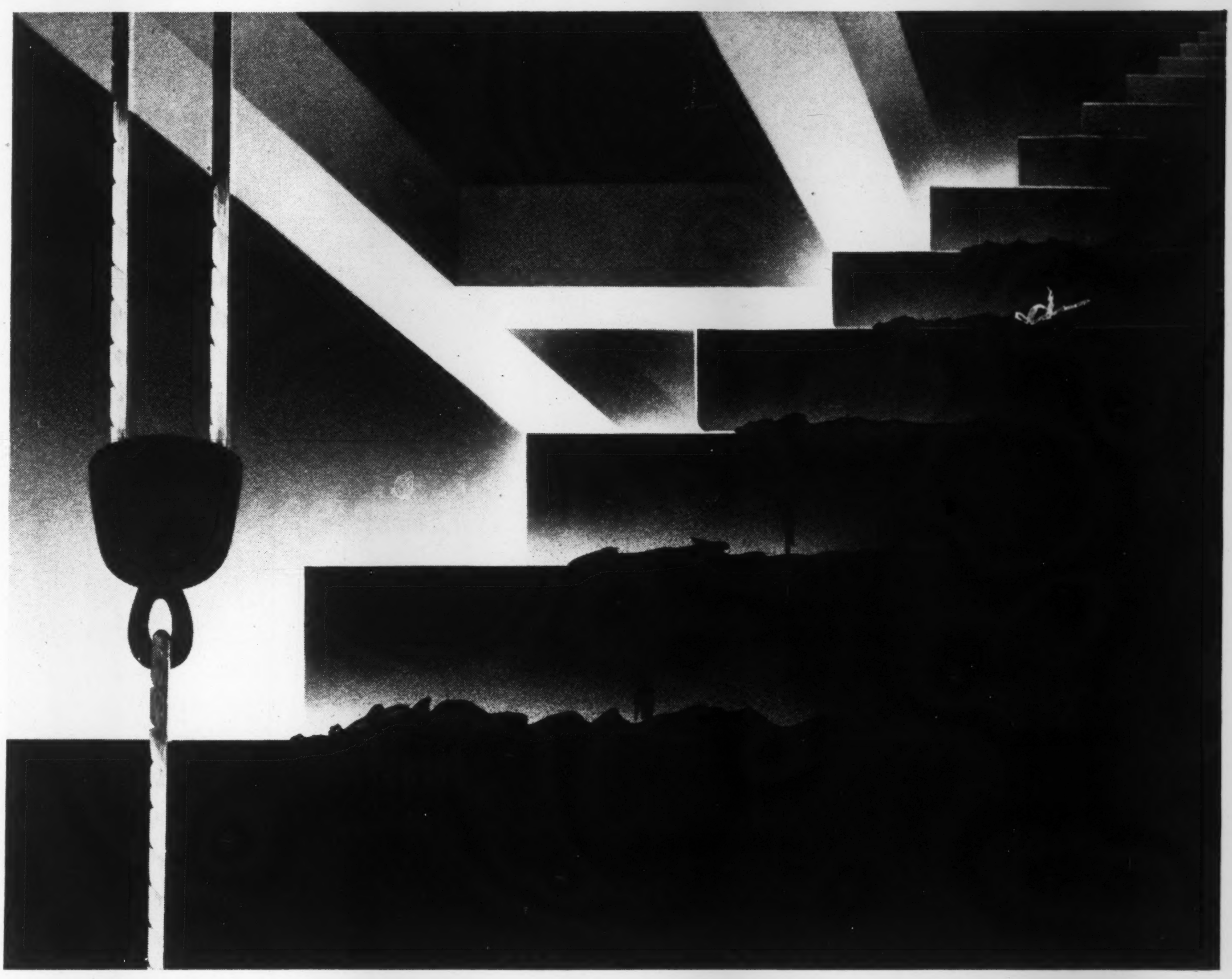
The original report of the joint A.G.A.-A.S.M.E. Committee covering the procedure, conclusions and data of the research on orifice coefficients is very voluminous and was given, accordingly, only limited distribution. The A.S.M.E. Research Committee on Fluid Meters has arranged, therefore, for the publication of an edition of the report omitting the extensive supporting data. This pamphlet is now available.

While the research on flow nozzles is as yet not complete, this edition of Part I contains full references to the experimental results so far obtained on the long radius nozzle. It contains also a brief discussion of the I.S.A. nozzle, the form developed by a committee of the International Standards Association.

Since the organization of this research committee in 1916, R. J. S. Pigott, Staff Engineer, Gulf Research and Development Company, Pittsburgh, Pa., has been its chairman. About the time of the reorganization of the committee of 1926 J. R. Carlton, engineer, Public Service Electric and Gas Company, Irvington, N. J., was elected secretary. The editing of the present revision of Part I of the report was assigned to H. S. Bean, Physicist, National Bureau of Standards, Washington, D. C., a member of the committee.

For further information—address

The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.



Maintenance saved is money earned

EVEN in products or equipment in which maintenance involves merely routine repairs, the use of Molybdenum steels can effect worth-while economies. But when maintenance also involves the cost of new parts, replacement labor, service interruptions, time and profit losses, the infinitely greater wearing qualities of Moly steels mean savings too substantial to be overlooked.

One of many actual instances proving the capacity of Moly steels to withstand rough service over long periods, is found in the lift-chain bushings of sand diggers. Chrome-Moly steel bushings replaced the former kind. Although subjected to terrific battering and continuous service, their records showed a decided increase in life and, consequently, a decrease in service interruptions and maintenance costs.

Under virtually every kind of operating condition, Moly steels and irons will prove their economy through greater strength and longer wear. Investigate. Send for our technical book, "Molybdenum." Ask us to mail you our monthly news-sheet, "The Moly Matrix." Consult our laboratory on your difficult ferrous problems. Climax Molybdenum Co., 500 Fifth Ave., New York.

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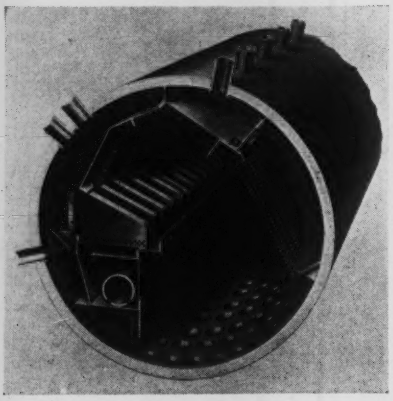
Bubble-Type Steam Washer

A steam washer has been developed by Combustion Engineering Co., Inc., 200 Madison Ave., New York, N. Y., which functions on the principle of removing entrained solids from the steam by forcing it to bubble through clean feedwater. This washer has been subjected to long and extensive tests under regular operating conditions in one of the large power stations, and as a result of the satisfactory performance a number of subsequent installations have been made.



Referring to the illustration, the feedwater enters the trough at the lower left through the longitudinal perforated pipe and spills over the notched weir. Mounted over the trough are a series of compartments, or hoods, open at the bottom and left and having perforations near the bottom of the side walls. These hoods are joined together by plate at the left and over them is bolted a continuous plate which extends to the top of the drum. Thus the steam entering the drum through the tubes at the left is compelled to pass into the hoods and out through the apertures, and bubbles through the feedwater, in which operation the entrained solids are removed. The actual washing of the steam is obtained not alone by bubbling through the water but also by the violent mixing of steam and water between the elements as created by the velocity of steam through the perforations. The construction is such as to prevent comingling of the feedwater with the water in the drum. The screen at the right is for the removal of moisture that may be carried along with the steam.

The washer is so located as to leave space for ready access for cleaning without removing it from the drum. However, should it be desired for any reason to remove the washer this may be readily done in sections, as the parts are bolted together.

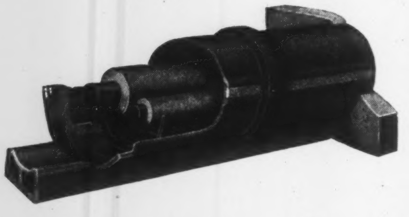
New Ajax Shaler Purifier Sieve Drive

The Ajax Flexible Coupling Co., 112 English Street, Westfield, N. Y., announces the new Ajax Shaler Purifier Sieve Drive operating on basic principles of Balanced Drive to improve the mechanical action of the sieve by imparting a smooth, perfectly uniform motion providing even flow of stock for close separation of middlings. By the application of fundamental laws of balanced forces, this new Ajax Shaler Purifier Sieve Drive eliminates all necessity for eccentrics. Its use and application of Balanced Drive confines the reciprocating action to the sieve and thus eliminates all vibration of machine frame or building due to the kinetic forces being equalized in both directions of travel and thus automatically canceling out. Operating records show low power consumption, and this, together with amazingly quiet operation, indicate its correct principles of design with reference to control of forces.

The entire driving mechanism runs on ball bearings requiring no adjustment. The driving unit is totally enclosed in an oil tight housing, eliminating fire hazard and ending necessity for constant bearing adjustments. The Ajax Shaler Purifier Sieve Drive is designed and built expressly for the one purpose, and is easily installed on your present purifiers. They have demonstrated their performance in actual operation in flour mills, and show substantially improved overall operating efficiency of purifiers. They are a specialized adaptation of the Ajax Shaler Shaker which has been widely adopted throughout the milling industry for receiving separators and conveyors.

A New ADSCO Product

A new type of conduit for underground steam and hot water lines known as ADSCO-Bannon Tile Conduit is being placed on the market by the American District Steam Co., North Tonawanda, N. Y., pioneers in the development of steam distribution equipment for over 50 years.

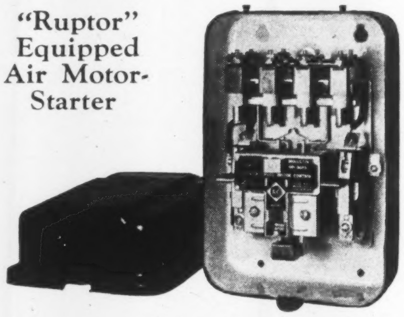


ADSCO-Bannon Tile Conduit is simple in design and is easily installed at low labor cost. It consists of a substantial base drain tile supporting a circular, salt glazed, vitrified tile conduit. The tile Conduit, with bell and spigot joints in approximately 2 ft lengths, is separable on the job into two halves along the horizontal center line with a resulting diagonal fracture. The bottom half of the conduit is placed on the base drain, the joints mortared and the trench backfilled to approximately the top of the half section of conduit. Pipe rollers or multiple pipe supports with rollers are placed in recesses in the two horizontal, reinforcing ribs which are in the bottom of the pipe support sections of conduit. The pipe supports are held rigid without piercing the conduit wall.

One or more pipes can be installed, tested, inspected and insulated with standard insulations before the top half of the conduit is placed. The top and bottom halves of the conduit are sealed with mortar in the bell and spigot joints and between the projecting outside lips on each side of the conduit, then the trench is ready for backfill.

ADSCO-Bannon Tile Conduit is available in various sizes to accommodate one or more pipes, with or without insulation. Sectional asbestos or any one of several filler types of insulation, such as rock wool, can be used in the conduit. ADSCO Bulletin No. 35-67, illustrating and describing ADSCO-Bannon Tile Conduit is available.

"Ruptor" Equipped Air Motor-Starter



The Allis-Chalmers Manufacturing Co., Condit Works, Boston, Mass., announces a new type of across-the-line air motor-starter equipped with "Ruptors," known as type AP-7. The "Ruptors" are enclosing chambers which confine and depotentiate the arc formed by circuit interruption. These "arc-depotentiating chambers" greatly increase the interrupting ability of the contacts, and form an isolating barrier between contacts of opposite polarity. Other features include: vertical make and break—silent operation; enclosed temperature overload relays, affording positive motor protection; unit construction—pole units consisting of individual molded bases mounted on a steel chassis, thus assuring true contact alignment; large silver double break contacts—no contact dressing needed; contacts accessible and quickly renewable; pilot circuit isolated from motor circuit, permitting a separate control voltage for push-button circuit where necessary; motor starter unit arranged for flat surface mounting when applied without enclosure. The starter is furnished for 7½ H.P. at 440 and 550 volts, 5 H.P. at 220 volts, and 3 H.P. at 110 volts.

A New Booklet on The B&W Direct-Firing Pulverized-Coal System

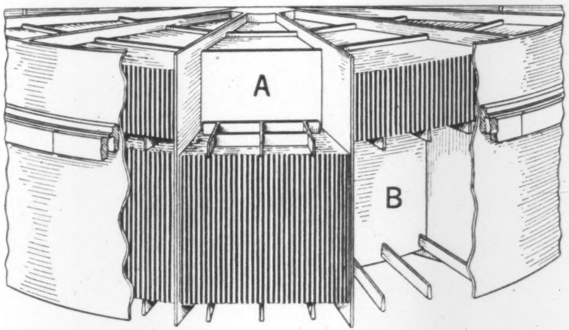
In view of the present wide use of pulverized-coal firing for power boilers and other applications, a new booklet, The B&W Direct-Firing Pulverized-Coal System, just issued by The Babcock & Wilcox Company, should be of interest. It is a presentation not merely of B&W Equipment but of the direct-firing pulverized-coal system from bin to burners.

The advantages of the B&W Direct-Firing System in reliability, efficiency, ease of operation, and safety are clearly stated. Such important features of the well-known Type B Pulverizer as sustained high fineness and capacity, low maintenance, and reliability are also presented. The booklet also contains considerable useful engineering information.

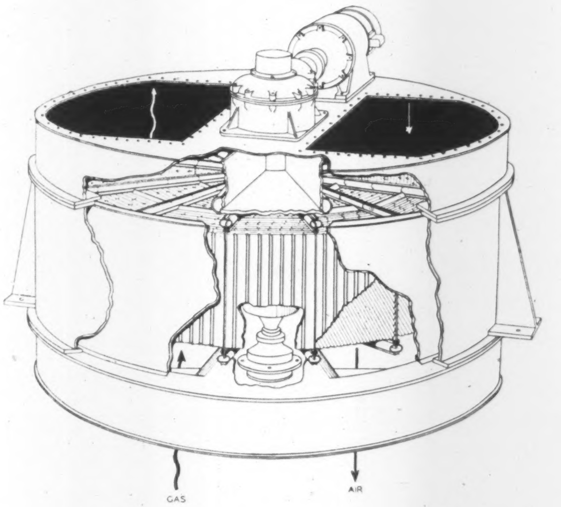
Copies of the booklet may be had on application to The Babcock & Wilcox Company, 85 Liberty Street, New York, N. Y.

AIR PREHEATERS

Maximum Heat Transfer, *with*
Minimum Maintenance Cost



Top view shows portion of Ljungstrom rotor with divided heating elements. The short top layer being removed from cell "A", and the longer bottom layer from cell "B". Lower view of Ljungstrom preheater is cut away to show elements and lower guide bearing.



The working parts of the Ljungstrom air preheater have been totally enclosed, simplified and reduced to the minimum.

The heating surface of Ljungstrom air preheaters, made from sheet steel, is inserted in the cells of the rotor.

The whole of the heating surface can readily be replaced at a fraction of the original cost of the preheater.

The heating surface can be furnished in two or more layers. It can be so proportioned that the layer most likely to require renewing is made shallow . . . thus further reducing maintenance cost, and service interruption.

• • •

For the same heat recovery one inch of Ljungstrom heating surface is approximately equivalent to one foot of plate or tubular heating surface.

Ljungstrom

Other Types

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Under Management of THE SUPERHEATER CO.
60 East 42nd Street New York, N. Y.

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Welding fittings at their best

WELD your pipe lines—for added safety and added strength with lighter weight — for smooth-flow interiors — for smooth, sightly, easily insulated exteriors.

Taylor WeldELLS head the list of Taylor Forge *Engineered* Welding Fittings. They are reinforced at the crotch where strain is greatest—have tangents which remove the weld from the curved section—have machine tool bevelled welding surfaces which permit sound, dense welds.

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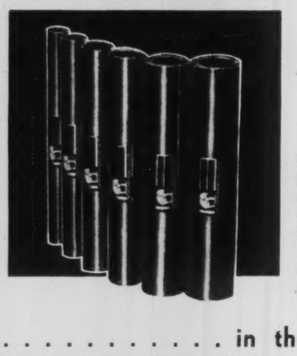

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ELEPHANT BRAND PHOSPHOR BRONZE BUSHINGS come to you machined with 1/32" plus O.D. and 1/32" minus on the I.D., up to and including 3" diameter . . . and from 3" to 6" inclusive, with 1/16" plus O.D. and 1/16" minus on the I.D. Maximum I.D. S-4".

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214 Stock Sizes from which to choose. Listed in stock sheet which is yours upon request.

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News of Interest to Manufacturers

Straight Pipe Threads

The application of the American Standard for Taper Pipe Threads (ASA B2–1919) in the various branches of industry developed the need for internal straight pipe threads for certain types of fittings to mate with the external taper pipe thread and for combinations of straight external and internal pipe threads of various pitch diameters. Detailed dimensions of these series are accordingly being included in the revision of B2–1919.

The six types of joints employing straight external and internal pipe threads are the following: (1) pressure tight joints for pipe couplings; (2) pressure tight joints for grease cup, gasoline, and oil fittings; (3) free fitting mechanical joints for fixtures; (4) loose fitting mechanical joints for rigid steel conduit and fittings; (5) loose fitting mechanical joints with locknuts; and (6) loose fitting mechanical joints for swivel nuts on hose couplings. In every case the form of thread is the same as that of the American Standard for Taper Pipe Threads, namely, that the angle between the sides of the thread is 60 deg when measured in the axial plane and the line bisecting this angle is perpendicular to the axis.

The complete dimensions of the pipe used in type (1) joints are given in the present American Standard B2–1919. It has been found convenient, however, to make type (2) joints in three ways, first, by a pipe joint consisting of two taper pipe threads (external and internal), second, by a taper external pipe thread and a straight internal pipe thread, or, third, by two straight machine screw threads drawn up to a shoulder. The basic pitch diameter of these straight internal and external pipe threads is equal to the diameter of the thread at the gaging notches of the plug and ring gages. In the case of type (2) thread, however, the tops of the external threads and the roots of the internal threads are truncated slightly by modifying the standard tools to insure grease tight joints.

The locknut thread is a good example of a straight pipe thread having the largest diameter that it is possible to cut on standard pipe. The assembly of parts threaded to the standard dimensions provides a loose fit which makes it necessary to use packing or a gasket where a pressure tight joint is required. These threads are used also for mechanical joints, such as are employed in certain joints of rigid steel conduit. Thin nuts threaded with the internal locknut thread may be used to connect to outlet boxes rigid steel conduit having the standard taper pipe thread.

To join small hose ($^1/_2$ to 2 in.) to the ends of wrought-iron or wrought-steel pipe a series of standard hose couplings has been developed whose swivel nuts have straight pipe threads with dimensions permitting a tight gasket joint with the American Standard Taper Pipe Thread. The pitches in this series of screw threads are those of the American Standard Taper Pipe Thread while the thread form is the American National form.

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AT YOUR SERVICE . . . TO CUT COSTS

A Chrome-Molybdenum (4120) carburizing steel is now available for mass production. It brings the cost of carburized parts down to new and more practical levels. It costs less than any other high-grade alloy carburizing steel. Its core properties are equal to those of the more expensive grades.

Made to controlled grain size, it:

1 Is low in cost.
2 Quenches from the box with minimum uniform distortion.
3 Takes a very hard, scuff-resistant case.
4 Develops good core properties.
5 Has excellent machinability.

Thanks to these qualities, it has already met the requirements of one of the toughest assignments — automotive hypoid gears — and has cut the production costs considerably.

It will cut costs, and improve performance, on any job where maximum core properties are not essential. Write for details — investigation will pay. . . . Climax Molybdenum Company, 500 Fifth Avenue, New York City.

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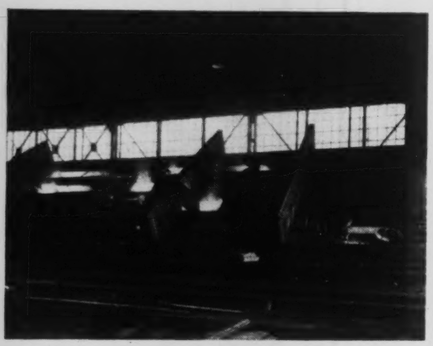
• NEW EQUIPMENT

New Electrode for Fillet Welding

A new electrode which eliminates necessity or multiple pass welding in production of fillet and lap welds in many applications, and which permits production of such welds without undercutting or overlap, is announced by The Lincoln Electric Co., Cleveland, Ohio. Fillet welds up to 3/8" in size with one plate vertical, can be produced in one pass with the electrode. The welds show no undercutting at the vertical plate and no overlap at the horizontal plate. Fillet welds of any size can be made more easily, of better quality and at higher speed with the electrode than was heretofore possible. The advantages will be apparent in all applications for fillet welding including shipbuilding, bridge and building construction, fabrication and manufacture. The new electrode, designated as "Fleetweld 8," is the result of considerable research and experiment by Lincoln engineers to develop an electrode which would simplify fillet welding and improve its quality and economy.



The new electrode is heavily coated for welding by the shielded arc process. The welds produced are smooth and dense with notably high physical properties. The tensile strength of the weld metal as deposited is 68,000 to 72,000 lbs. per sq. in. Ductility is 20% to 30% elongation in 2" as deposited, and 30 to 36% stress relieved. Other properties including resistance to fatigue, impact and corrosion are equal to or better than mild steel. "Fleetweld 8" comes in 14 and 18" lengths. The 14" lengths are made in 3/8", 5/16", 1/4", 3/16" and 5/32" sizes while the 18" lengths come only in the 3/8", 5/16" and 1/4" sizes. The electrode will be found of particular value by firms whose products require production of high quality fillet and lap welds at maximum speed and economy.

Steelflex Couplings

An improved design of flexible coupling is offered by the Falk Corporation, Milwaukee, Wisc., under the trade name "Steelflex Couplings." This design uses the basic principle employed in previous designs of Falk Flexible Coupling based on shock absorption and compensation for misalignment through the action of a resilient grid member. Details of design have been improved through the use of symmetrical design on both the driving and driven hubs and also through the use of a symmetrical design on the halves of the coupling cover which protect the operating elements and act as a grease reservoir for the coupling lubricant. The openings between the shell and the coupling hubs are effectively sealed against leakage of lubricant as well as the entrance of dirt or foreign material through the use of moulded Neoprene seals. The FA type Steelflex coupling is available in ratings from .4HP to 18000HP. All commercial sizes are available for stock shipment and arrangements are being completed to make the coupling available in distributors' stock in all important industrial centers. The forty page Falk Steelflex Coupling Bulletin, No. 4100, describing the new FA series has just been announced. This bulletin covers specification, design, rating, method of selection, and dimensions. It also contains a very interesting section of installation photographs.

Fractional H.P. Air Compressors

Ingersoll-Rand Co., 11 Broadway, New York, N. Y., has announced a new line of fractional horsepower air compressors. These units are made in 1/4 and 1/2 horsepower sizes. These units are very compact and neat in appearance. They have automatic start and stop control, are equipped with a new style seamless steel tank, and an improved check valve.

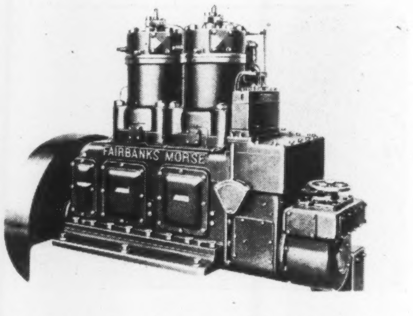
When furnished for single phase current they are equipped with a brushless capacitor type motor and a built-in automatic protection switch giving overload and undervoltage protection. They are rated for 150 pounds per sq. in. maximum pressure, but may be set for lower pressures, or may be equipped with a reducing valve for still lower pressures. The 1/4 and 1/2 horsepower units are available on a 2.4 cu. ft. tank. This unit is less than 35 inches high. The 1/2 horsepower size is also available on a 4.6 cu. ft. tank in either vertical or horizontal mounting. If desired the units can be furnished less the tank. The units are furnished in an attractive opalescent brown. Literature is available on request.

Man-Mountain Demonstrates Valve

The illustration shows Martin Levy, 620 pound man-mountain wrestler smashing a nail between the seat and disc of one of the new Hancock Bronze Globe Valves manufactured by the Hancock Valve Division, Consolidated Ashcroft Hancock Co. It emphasizes the outstanding feature of these new Hancocks, namely, their heat-treated stainless steel seats, and discs of 500 Brinell hardness. It brings to life their claim that boiler scale, pipe turnings and nails can be smashed between these superhard seats and discs without leaving a trace of a mark on either seat or disc.

New Heavy Duty Diesel for the Small Power User

A new Fairbanks-Morse Diesel, the Model 42-E, has been developed to meet the demand of small power users for a heavy-duty, continuous-service stationary engine. It is available in two- and three-cylinder combinations with ratings of 60 and 90 horsepower at 450 r. p. m., and can be furnished for direct-connected, belt or electric generator drive. With an 8 3/4 in. bore and 10 1/2-in. stroke, this Diesel is smaller and lighter than the F-M Model 32-E, but it embodies all of the proven features that have led to the daily use of several hundred thousand horsepower of the larger engines. It is small enough to be installed where space and head room are limited, and it is applicable for any power requirement within its horsepower ratings.



This new model Diesel is characterized by extreme simplicity of design and operation. Two important principles, direct airless injection of fuel and two-cycle design with crankcase scavenging, result in use of an absolute minimum of moving parts. This, along with a medium-low speed, of course, means greater reliability and lower maintenance cost. The engines are conservatively rated as to capacity, piston speed and bearing pressures, and will operate continuously at rated capacity with no danger of overheating or of strain to any part. Further details regarding this new F-M Model 42-E Diesel will be found in a bulletin now available upon request from Fairbanks, Morse & Co., 900 S. Wabash, Chicago, Ill.

New Turbine-Generator at Rouge Plant

The Ford Motor Company is preparing to increase by 50 per cent the installed capacity in large 1200-pound-steam turbines at the River Rouge plant, at Detroit. A third 110,000-kilowatt turbine-generator unit will be added to the present power plant, making the total installed capacity 350,000 kilowatts.

The new vertical compound turbine will be a duplicate of the second 110,000-kilowatt unit, recently installed, for steam conditions of 1200 pounds, 900 F and one inch back pressure. The 1800-rpm high-pressure turbine and generator are mounted on top of the 1800-rpm double-flow low pressure unit. Hydrogen cooling is employed for the generators, to provide for increased efficiency of operation. The generators will be the 13th and 14th large turbine-driven

Continued on Page 18

AIR PREHEATERS

Ljungstrom

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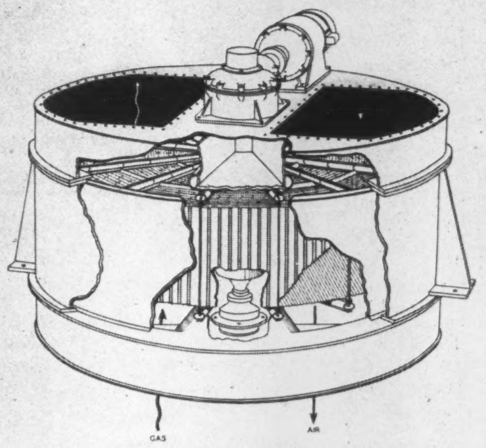
HIGH HEAT

Recoveries



one inch of Ljungstrom heating surface is approximately equivalent to one foot of plate or tubular heating surface

Ljungstrom

Other Types

To obtain maximum efficiency from boilers operating with high pressures and temperatures, it is necessary to recover a large percentage of the available heat in the stack gases.

The Ljungstrom air preheater, by employing the continuous regenerative counterflow principle, assures the highest practical heat recovery (up to 70% of the total heat in stack gases).

THE AIR PREHEATER CORPORATION

Under Management of THE SUPERHEATER CO.
60 East 42nd Street New York, N. Y.

A—1119

• Keep Informed . . .

Continued from page 16

units designed for hydrogen cooling to be built at the Schenectady Works of the General Electric Company. Hydrogen, when used as a circulating medium in large generators, reduces windage losses to 10 per cent of what they would be with air, and this results in an improvement in the efficiency of the generators of from 0.6 to 1.1 per cent, depending on the size and rpm of the units.

Hydrogen requires considerably less pressure to circulate the necessary volume, and it has many times the thermal conductivity of air. It also removes more heat from a given surface for the same temperature drop. The circulating hydrogen is cooled by fin-type coolers located within the generator framework. This construction results in a very compact installation as the large housing and the surface air coolers, external to the framework, can be dispensed with.

Ford officials state that the increased power capacity in the Rouge plant will provide for a huge increase in Ford production.

• *BUSINESS CHANGES*

Appointed Chief Consulting Engineer

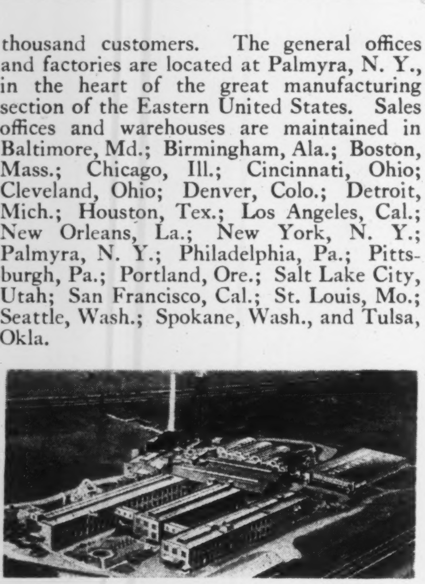
Robert F. Vogt, Allis-Chalmers Mfg. Company, Milwaukee, Wisc., Assistant Chief Consulting Engineer since 1921, has been appointed Chief Consulting Engineer, to succeed the late J. F. Max Patitz. Mr. Vogt is a graduate of the Swiss Polytechnicum at Zurich where he was a pupil of Dr. A. Stodola. His professional career began in the United States in 1903. He has been connected with Allis-Chlamers since 1907, entering as mechanical engineer, and has been connected with many activities relative to the design and development of sundry equipment of various Departments. He is a member of The American Society of Mechanical Engineers. He has written a number of technical papers. Several more recent ones have had to do with helical springs, several simple but accurate formulas having been developed by him for determining stresses in them.

GARLOCK Celebrates 50th Anniversary

This year is the Golden Anniversary of The Garlock Packing Co., for it was just fifty years ago that this company began the manufacture of mechanical packings at Palmyra, N. Y. The Village of Palmyra can rightly be called the cradle of the mechanical packing industry of America. It was here, shortly after the close of the Civil War, that one of the founders of The Garlock Packing Company conceived the idea of making mechanical packings by cutting a ring from an old piece of rubber hose and putting it in a stuffing box of an engine used to furnish power to a saw mill. The experiment proved to be so successful that similar packing rings and washers were cut from a supply of the same material and sold to the different users of steam engines throughout the vicinity.

This was the beginning and nucleus of the mechanical packing business. In the year of 1887 The Garlock Packing Company was founded and, with a handful of employees, started the first manufacture of mechanical packings on a commercial basis.

Today, after a half century of progress, Garlock has over one thousand employees, including a corps of representatives, who sell hundreds of Garlock products to some forty thousand customers. The general offices and factories are located at Palmyra, N. Y., in the heart of the great manufacturing section of the Eastern United States. Sales offices and warehouses are maintained in Baltimore, Md.; Birmingham, Ala.; Boston, Mass.; Chicago, Ill.; Cincinnati, Ohio; Cleveland, Ohio; Denver, Colo.; Detroit, Mich.; Houston, Tex.; Los Angeles, Cal.; New Orleans, La.; New York, N. Y.; Palmyra, N. Y.; Philadelphia, Pa.; Pittsburgh, Pa.; Portland, Ore.; Salt Lake City, Utah; San Francisco, Cal.; St. Louis, Mo.; Seattle, Wash.; Spokane, Wash., and Tulsa, Okla.



The illustration shows the main factories located at Palmyra, N. Y. Branch factories are operated at Birmingham, Ala., Denver, Colo., and San Francisco, Cal. The Canadian factory is located at Hamilton, Ont., and sales offices and warehouses are maintained in six leading Canadian cities.

Garlock products have always been produced and sold on a Quality and Service basis. They are known as "Quality Controlled" commodities because their complete manufacture, from the crude to the finished product, takes place in the several Garlock factories. By the maintenance of this policy, Garlock Packings have been used as the basis of comparison for all other packings and have earned for themselves the name of "The Standard Packing of the World."

Organizes Industrial Department

On March 1st, B. F. Sturtevant Co., Hyde Park, Mass., announced the creation of an Industrial Department which will act as a liaison between the company and industrials to promote the sale and application of all Sturtevant Air Handling Equipment. This department will work very closely with Consulting Engineers, Plant Engineers and Production Executives to insure correct design of air handling systems for drying, pneumatic conveying, dust removal and vapor absorption, and the selection of proper equipment for these systems.

The activities of this department will be directed by Mr. J. C. Thompson formerly manager of Sturtevant's Washington, D. C., office and prior to that, manager of the southern territory with headquarters in Atlanta, Ga. Mr. Thompson will make his headquarters in the executive offices of the company at Hyde Park, Boston, Mass.

Consolidation of Crane Sales Departments

P. R. Mork, vice president in charge of sales, Crane Co. Chicago, announces the co-ordination of all activities concerned with the estimating, engineering, or sales of valves, fittings, pipe, and fabricated piping into one unit, the Valve and Fitting Department, with Mr. W. H. Pape as manager. Mr. Pape enters his new position with 25 years' experience covering a wide range of industrial applications of Crane products. His first activity was in heavy railroad construction followed by similar work on New York subways. In 1914 he entered the oil industry serving subsequently as designer, operator, and sales engineer. He joined the Crane organization in 1927 as special representative in New York and later in the Boston territory. For 6 years he was in the Oklahoma and Gulf Coast oil fields, and for the past $1^1/_2$ years has been manager of the Oil Sales Department in the general office, Chicago.

The former Industrial Sales Department and Engineering Sales Department are consolidated into a new section—the Engineering Sales Section of the Valve and Fitting Department with Mr. E. Burke as manager of this section, Mr. G. F. Wright, assistant manager in charge of estimating and other activities dealing with fabricated pipe and allied products, and Mr. W. F. Lahl, assistant manager, supervising the Industrial Zone Men in the field. Mr. J. H. Barker is manager of the Sales Quotation Section of the Valve and Fitting Department. Other sections of the new consolidated department include Pipe Sales, Marine Sales, Oil Sales, Railroad Sales, and Water Works Sales.

Worthington Appoints General Sales Manager

The appointment of J. J. Summersby, Assistant Vice-President of Worthington Pump and Machinery Corporation, as General Sales Manager of that Corporation is announced. This appointment is an extension of Mr. Summersby's previous responsibilities, for a further concentration of direction of the Corporation's general sales department. Mr. Summersby joined the Worthington Pump and Machinery Corporation as a sales engineer immediately after his completion of post-graduate work at Washington University in 1920, and has been continuously identified with the Corporation since then as district sales manager, divisional sales manager and assistant general sales manager.

• *LATEST CATALOGS*

Vibrating Coal Screens

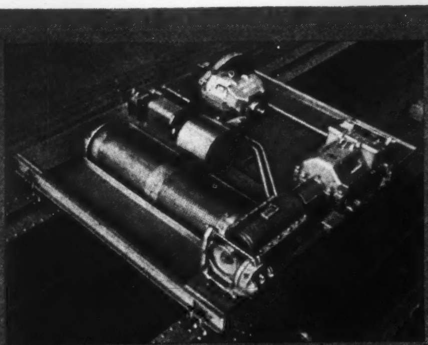
Allis-Chalmers Mfg. Company, Milwaukee, Wisconsin, has just issued an attractive new and revised 12 page bulletin No. 1476A devoted to the subject of Coal Screens, giving illustrations of various types of vibrating screens, representative installation views, as well as sizes and dimensions.

Advanced Sourcebook of Spring Knowledge

One of the most complete, semi-technical discussions of springmaking in all its forms is now offered by Barnes-Gibson-Raymond of Detroit and Ann Arbor, Mich. It represents a distinct advance over their last catalog published in 1931, and reflects in a high degree the current trend away from the stereotyped catalog of products. Eighty-eight pages of usable information about spring selection and designs, most of it published for the first time, make this a book to be welcomed in any file of engineering data. In addition to discussing the characteristics of the many spring types, numerous problems in design are actually worked out for easier understanding. The subject matter is clearly indexed and conveniently grouped for reference.

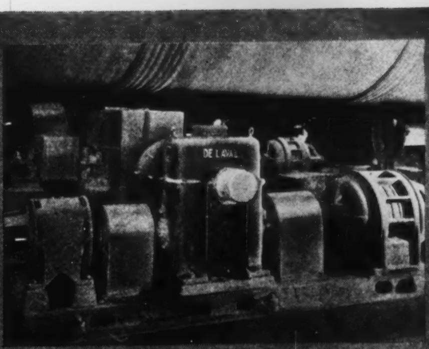
Research and laboratory experiment have always been a strong suit in these two spring plants and the results are apparent in the

Continued on Page 20

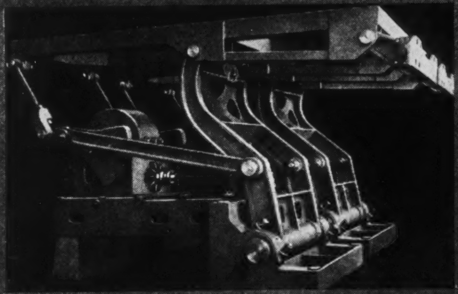


Trolley of heavy duty crane

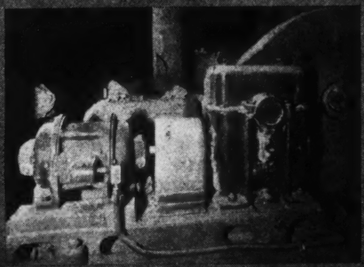
Billet pusher



Cement kiln



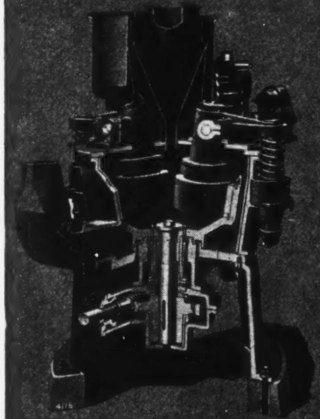
Slab pusher



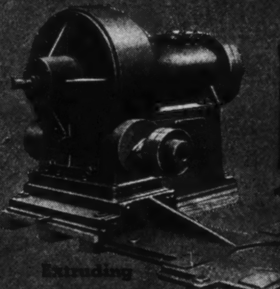
Drag conveyor

←Upcut bloom shear

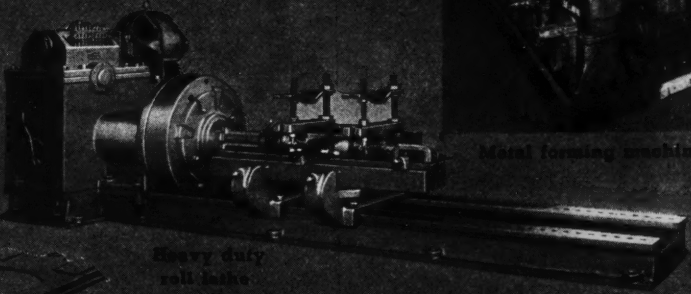
Metal forming machine



Bowl pulverizing mill



Extruding machine



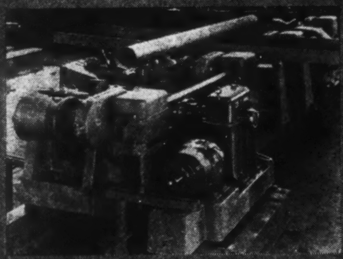
Heavy duty roll lathe

DE LAVAL *Worm Gear* DRIVES

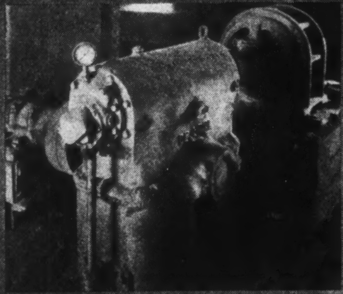
HEAVY DUTY MACHINERY in steel mills, cement mills, coal mines, paper mills, the rubber industry, and wherever there are exacting or adverse conditions, has for many years been kept in continuous, reliable operation by De Laval Worm Gears.

A De Laval Worm Gear drive can be obtained either complete ready to couple to motor and driven machine, or the worm and worm wheel can be supplied for the machinery builder to incorporate in his own design. Our experience of more than a score of years in the application of worm gears and in the manufacture of precision machinery is thus built into your machines.

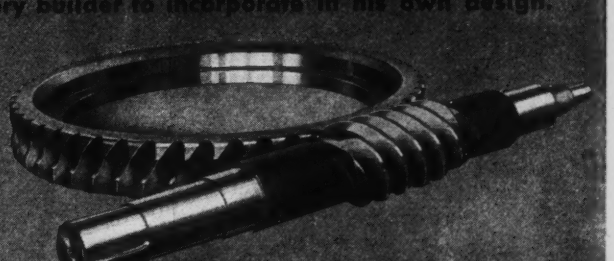
Let our engineers recommend the most suitable drive



Manipulator table of pipe machine



Bucket elevator



DE LAVAL STEAM TURBINE COMPANY, TRENTON, N. J.

1100

• Keep Informed . . .

Continued from page 18

tables and formulas which have been compiled for quick accurate use. The B-G-R sourcebook represents a large investment in time and experience and should be valuable for the help it can give in buying or designing springs. It will be sent without obligation to any executive, engineer, designer, or purchasing agent who requests it on his business letterhead.

New Turbine Bulletin

A new bulletin S-116 entitled "The Terry Wheel Turbine" has just been issued by The Terry Steam Turbine Co., Hartford, Conn.

Brown Analy-Graph

The Brown Instrument Co., 4496 Wayne Ave., Philadelphia, Pa., has just published a new folder entitled—"Standardizes Quality in the Heat Treatment of Metals." This folder describes the advantages of using the Brown ANALY-GRAPH in heat treating processes. The Brown ANALYGRAPH exactly records the minute changes in the chemical composition of furnace atmosphere—replacing guesswork with accuracy. A description of the Brown PROTECTOGLO (Combustion Safeguard) System is also included in this folder.

Light Weight Structural Metals

Increased emphasis has recently been placed upon light-weight construction throughout industry. The spotlight has, therefore, been cast upon properties of the various light alloys and the conflicting claims of their exponents.

Naturally, the selection of suitable light-weight structural materials has always been most important to the aircraft industry and is receiving equal consideration today. Rapid increase in stresses to which structural members are subjected, a resultant of higher average speeds and larger, heavier planes, and the longer service life now expected of aircraft, require increased stamina and greater dependence upon the strength-weight ratios of constructional materials.

Reprint of a recent article, "Is Aviation Ready for Stainless?" by E. J. W. Ragsdale which presents concisely the factors governing the selection of light-weight structural metals, is available and may be secured by writing to International Nickel Co., 67 Wall St., New York, N. Y.

Full Size Bearing Layouts

For the use of engineers, designers, draftsmen and others, the New Departure Division of General Motors Corp., Bristol, Conn., is offering a set of 19 sheets containing full size drawings of ball bearings for layout work. Single row, double row, radax, duplex and self-sealed bearings are included in a complete range of sizes for all series.

These sheets are mailed free to all who request them, being sent in covers which keep them flat and make them easy to place in a standard size letter file. Copies may be had by asking for Bearing Layout Folder LF, or Form No. 205.

Steam Generator

A new catalog just issued by Combustion Engineering Company, Inc., New York, describes its Type VU Steam Generator which is of standard construction, complete in sizes ranging from 15,000 to 250,000 lb of steam per hour and for any steam pressure up to 1000 lb per sq in. This is a two-drum unit, fired with pulverized coal, oil or gas, the burners being located in the front of the furnace with tangential admission of secondary air. The design is symmetrical in that any section taken through the unit from front to rear is similar to any other section so taken and the gases enter the tube bank at a practically constant temperature across the entire width of the unit. The setting is steel-encased. The catalog is fully illustrated with both exterior and cutaway views of the unit, line drawings and detailed sectional views of the burners; also details of the furnace wall construction, mills, etc., as well as descriptive matter and data.

Steam Turbine Improvement

How fuel costs in the generation of power can often be reduced by 25 to 50 per cent, or more, is pointed out in a paper entitled "Power and Heat Problems Yield to Improved Alloys and Designs," by C. R. Waller, Vice-President in Charge of Engineering, of the De Laval Steam Turbine Co., Trenton, N. J. Recent improvements in the design of steam turbines, and in the materials used for their production, permit of using steam in the region of high pressures and temperatures. As little additional fuel is required for the generation of steam at high pressure, the efficiency of condensing steam plants can in this way be greatly increased. Where steam is used for processing or heating, even at relatively high pressures, large amounts of power can also be obtained as a by-product, using the turbine as a pressure reducer and heat distributor. The possible savings with steam at various pressures and temperatures are presented in a table.

Recording Gauges

Several new bulletins on recording and controlling gauges have just been published by The Bristol Company, 21 Bridge St., Waterbury, Connecticut. These are bulletins No. 483, No. 484, No. 485, and No. 486.

Dust Collectors

The C. O. Bartlett &. Snow Co., 6450 Harvard Ave., Cleveland, Ohio, has just released its new bulletin, No. 79—Dust Collectors. This catalog, containing 36 pages, is complete not only with a description of the design and operation of the dust collecting equipment itself. . . but contains in addition, more than 8 pages of basic and extremely usable technical engineering data relating to air flow through pipes, etc., —and the solutions of two practical and very real dust collecting problems, showing the application and use of this engineering material.

Electro-Magnetic Feeders and Conveyors

Allis-Chalmers Mfg. Company, Milwaukee, Wisconsin, has put out a new illustrated Bulletin 1833 covering its recently announced Utah Electro-magnetic Feeders and conveyors which can be used to handle any dry or moist material that can ordinarily be handled, delivering it at a thoroughly uniform rate to crushers, screens, grinding mills, belt conveyors, concentrating the other processing equipment. The bulletin tells of its low power requirements, of inclination effects on the feed rate, of positive control for varying the feed rate, and gives table of sizes and capacities, and other pertinent information.

Pointers on Roofing and Siding

The subject of cutting maintenance costs on industrial roofing and siding is discussed in the new twelve page brochure, "J-M Corrugated Transite," published by Johns-Manville, 22 East 40th Street, New York City. How Corrugated Transite can be applied by any average workman is explained with the help of a full page of drawings showing construction details. Also illustrated are the special patented accessories that seal all Corrugated Transite joints and ridges. Typical installations pictured, illustrate how this asbestos-cement has served without maintenance for many years as roofing and siding in industries where unusually severe corrosive conditions exist.

Mortars and Plastics

A new eight-page fully-illustrated booklet presenting the general characteristics as well as specific properties of each of the five B & W Mortars and Plastics is announced by The Babcock & Wilcox Co., 85 Liberty St., New York, N. Y.

The selection of the correct mortar or plastic for each type of work is simplified by a reference table included in this booklet . . . one that also contains vitrification, melting, and use-limit temperatures, the weight or volume required for application, as well as the sizes of containers available.

Ball Bearings

Just off the press is the 1937 standard catalog on New Departure Ball Bearings issued by New Departure Division, General Motors Corp., Bristol, Conn. In addition to the up-to-date listing of all available types, sizes and list prices are interesting sections on Bearing Selection, Mounting Directions, Fits and Tolerances, Equivalent Bearing Tables and Telegraphic Code. Catalog is 146 pages, Wire-O bound, with tabs at each section for easy reference. Ask for Booklet "S."

COMING MEETINGS AND EXPOSITIONS

For the next three months

JULY

June 28–2	**American Society for Testing Materials,** Annual Meeting, Waldorf-Astoria, New York, N. Y.
June 28–2	**Society for the Promotion of Engineering Education,** Annual Meeting, Cambridge, Mass.
21–23	**American Society of Civil Engineers,** Annual Convention, Detroit, Mich.

AUGUST

31–Sept. 3	**American Institute of Electrical Engineers,** Pacific Coast Convention, Spokane, Wash.
30–Sept. 3	**American Association of Power Engineers,** Mississippi Valley Power Show & Mechanical Exposition, Jefferson Hotel, St. Louis, Mo.

SEPTEMBER

6–10	**American Chemical Society,** Fall Meeting, Rochester, N. Y.
13–18	**American Institute of Mining & Metallurgical Engineers,** Joint Meeting A.I.M.E. and Canadian Institute of Mining and Metallurgy, Vancouver, B. C.
Wk. of 27	**American Gas Association Convention,** Cleveland, Ohio
28–Oct. 1	**Association of Iron and Steel Engineers,** Convention and Iron and Steel Exposition, Hotel Stevens, Chicago, Ill.

Cost Sheets say it Pays

TO USE "THE BEST" IN IRON VALVES, TOO

6
125 WSP
200 OWG
TRADE
JENKINS
MARK
Jenkins Bros

FOR an answer to the question—*Does it pay to use "the best" in IRON valves?*—many concerns have turned to the record of valve maintenance and replacement expense in their cost sheets. It is a sure way to get the truth.

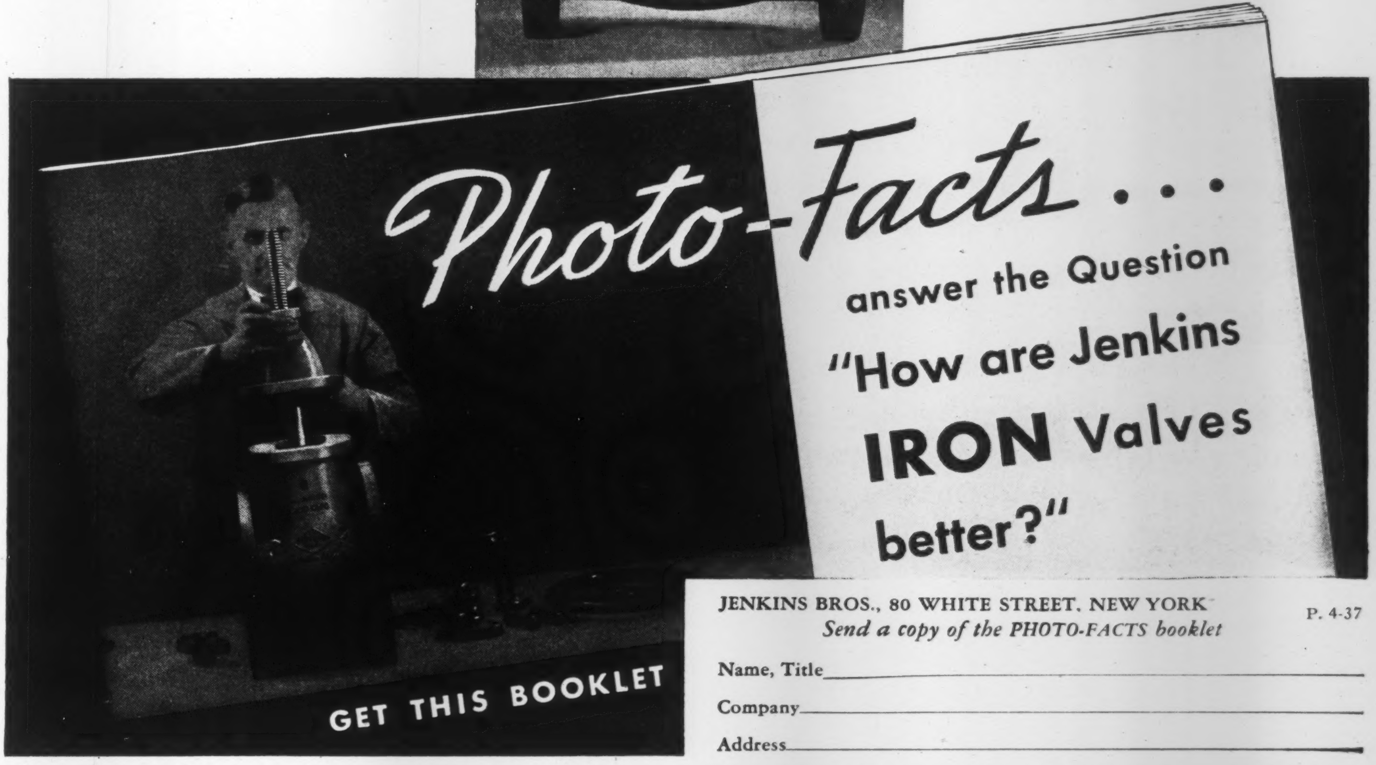
Records disclose the high cost of valve trouble on large lines... the great amount of time and labor expended when a large valve must be taken off a line for repairs... the lengthy shut-down, costly new parts or replacement which are frequently involved. The need for iron valves that will STAY in service, without trouble or expensive maintenance, is clearly seen. The figures show that ONLY "the best" is good enough where economy is the buyer's aim.

To hundreds of valve users "the best" in IRON valves, as well as Bronze Valves means "*Jenkins*". They find that the extra-quality which is built into all Jenkins Valves effects worthwhile savings on large lines by preventing costly trouble. To show you just what this extra-quality means in terms of IRON valves we have prepared the unique "PHOTO-FACTS" booklet below. In it are two dozen pictures worth seeing if you are seeking the best Iron Valves for your money.

Send the coupon, or ask your supply house for a copy. See what Jenkins offers... at the standard price of good valves.

JENKINS BROS., 80 White Street, New York; 510 Main Street, Bridgeport; 524 Atlantic Ave., Boston; 133 North Seventh Street, Philadelphia; 822 Washington Boulevard, Chicago; JENKINS BROS., Limited, Montreal, Can.; London, Eng.

JENKINS VALVES
BRONZE—IRON—STEEL



JENKINS BROS., 80 WHITE STREET, NEW YORK P. 4-37
Send a copy of the PHOTO-FACTS booklet

Name, Title____________________

Company____________________

Address____________________

ELEVATING
THE
Sights

THE higher the sights, the farther the travel —whether of projectiles or of business plans reaching far into the future.

This Company has been privileged through the past 25 years, to work with Design Engineers of many large machinery builders — whose "sights" were also high — in adapting Cleveland Worm Gear Drives into various new and original but trustworthy types of speed reduction. Thousands of worm gear units, both standard and special, have been installed in new machinery as the result of this fine Engineering co-operation.

The Cleveland Worm & Gear Company builds Worm Gear Reduction Units for use on equipment of major industries. Design is modern but conservative, production facilities are exceptionally well-planned, testing methods are of the newest. "Clevelands" operate for 10, 15 or more years without requiring any attention whatever.

District Representatives will consult with your own Engineers whenever convenient for you. The Cleveland Worm & Gear Company, 3264 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication.

CLEVELAND Worm Gear Drives

The *Standards* COLUMN

News of Interest to Manufacturers

Adjustable Adapters for Multiple Spindle Drilling Heads

When in 1931 the Sectional Committee on the Standardization of Small Tools and Machine Tool Elements (B5) voted to include this project in its program of activity, some of the committee members suggested that the project cover the complete multiple spindle drilling head with all of its parts. Technical Committee No. 18, of which G. A. Bouvier was then chairman, had not progressed very far, however, before it realized that the scope of the project should be considerably narrowed.

The committee correspondence and the discussions at meetings, notably the one held in Detroit in December, 1932, made plain that there was a sentiment in favor of the standardization of dimensions which would permit the transfer of spindles from old heads to heads of new design or the retention of such spindles in stock for repair purposes.

This standard represents the first step in that direction. These adapters are intended to supply the need for a standard device to permit vertical adjustment of taper shank tools when used with multiple spindle drilling heads. The committee evidently intends that these adapters shall form part of the permanent equipment of a shop since it has recommended that material of which they are to be made shall be chrome-nickel steel (S.A.E. 3120) or its equivalent, case hardened.

The taper sockets are reamed to fit the American Standard Tapers Nos. 1, 2, 3, and 4, and American Standard Woodruff Keys are used to make the driving connection between the spindle and the adapter.

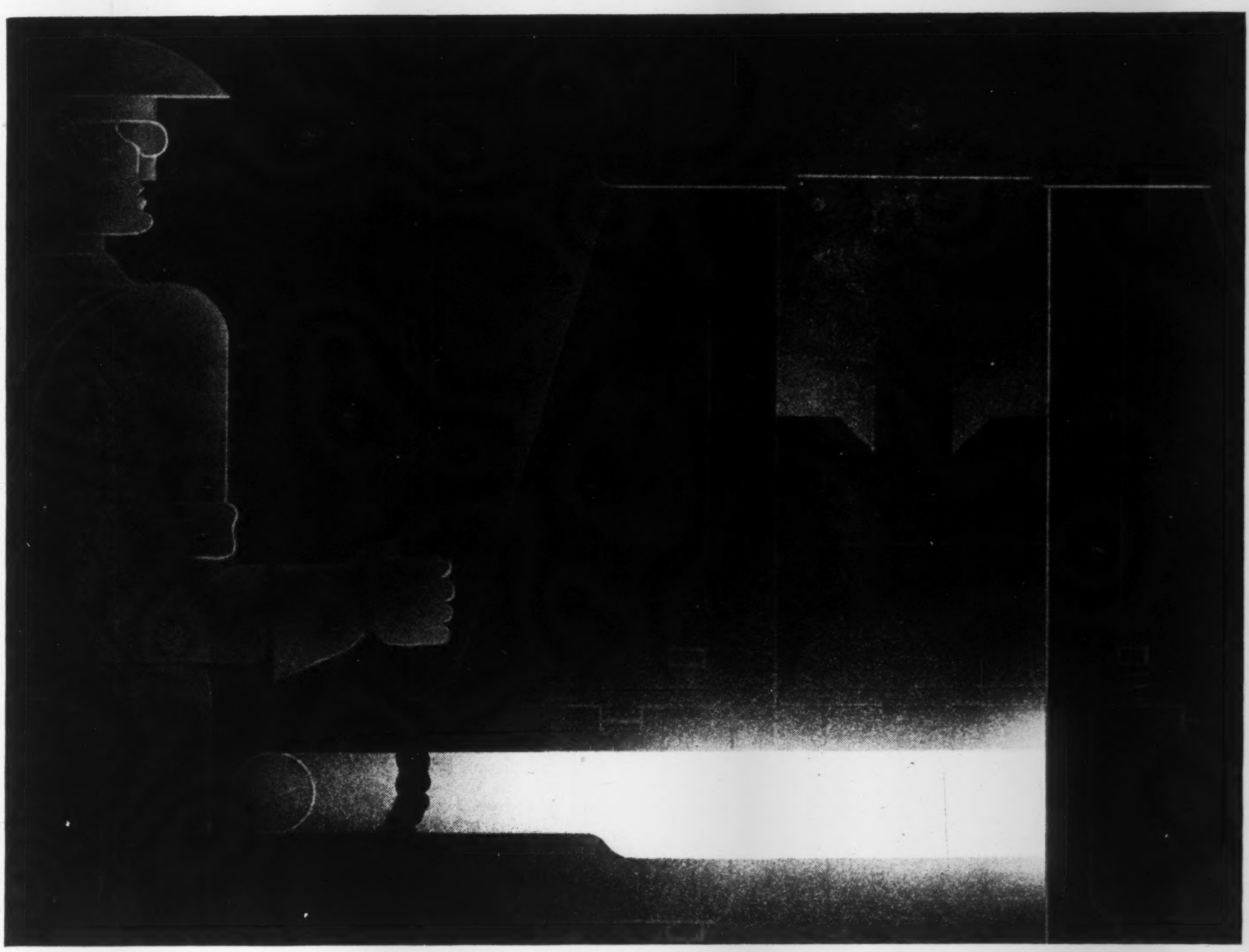
This project, as will be evident from the above, is organized under the procedure of the American Standards Association. The three sponsor societies are the NMTBA, SAE, and ASME. Its officers and committee members are given below.

COMMITTEE OFFICERS AND TECHNICAL COMMITTEE MEMBERS

William C. Mueller, *Chairman*, Sectional Committee B5, Manufacturing Planning Engineer, Western Electric Company, Chicago, Ill.
Joseph A. Anglada, *Secretary*, Sectional Committee B5, President, Anglada Motor Corporation, New York, N. Y.
William A. Timm, *Chairman*, Technical Committee, Machinery Process and Equipment Standardization, Western Electric Company, Chicago, Ill.
Paul Andree, Hoefer Manufacturing Company, Inc., Freeport, Ill.
William L. Barth, Standards Section, General Motors Corporation, Detroit, Mich.
C. E. Bleicher, Staff Master Mechanic, Dodge Brothers Corporation, Detroit, Mich.
George L. Buffington, Estimating Department, Ex-Cell-O Corporation, Detroit, Mich.
Joseph F. Buhr, Buhr Machine Tool Company, Ann Arbor, Mich.
A. G. Sudhoff, Standardization Engineer, National Automatic Tool Company, Richmond, Ind.
Herbert L. Tigges, Sales Manager, Baker Brothers, Inc., Toledo, Ohio
Herbert E. Wells, Assistant Superintendent, Tool Division, General Electric Company, Bridgeport, Conn.

For further information—address

The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.



Increasing the life of forging dies

Die renewal is always a factor in the production cost of forged parts. And when actual instances appear showing die expense being slashed and not just shaved, the subject becomes one of major importance.

Our records hold a recent case example in which die blocks from a former material lasted only a week to ten days. Blocks containing .20-.30 carbon, 3.5 nickel and .35 Moly lasted three months.

Since Moly greatly increases steel's resistance to sudden heat impact, it quite naturally adds to the life of forging dies and thus substantially cuts down production costs.

Our technical book, "Molybdenum," will prove useful to engineers and production heads interested in cost cutting and product improvement. Our monthly news-sheet, "The Moly Matrix," keeps its readers informed on Moly developments. Both sent free on request. Our laboratory is available for the study of special ferrous problems. Climax Molybdenum Co., 500 Fifth Ave., New York.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

MOLY

Climax Mo-lyb-den-um Company

•Keep Informed . . .

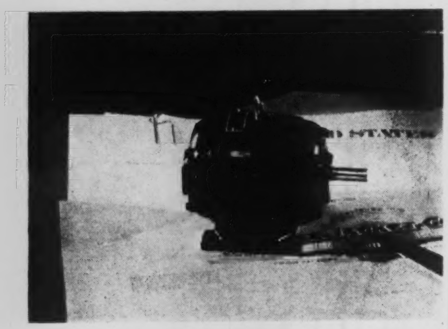
Available literature may be secured by addressing a request to the Advertising Department of MECHANICAL ENGINEERING or by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as the source.

Announcements from advertisers in MECHANICAL ENGINEERING and the MECHANICAL CATALOG

• *NEW EQUIPMENT*

Paper Weight of Bakelite Molded

Since "sampling" of heavy industrial machinery is seldom, if ever, practical, many manufacturers have turned to the use of miniature models as successful advertising novelties. To remind its customers and prospects that it manufactures induction polyphase motors, the Century Electric Company is distributing a miniature paper weight of lustrous black Bakelite molded. It is identical in contour to the large motor it represents, and is finding a welcome place on many an executive's desk. A particular advantage afforded in the use of plastics for miniature models is that once they have been molded, the models require no further finishing, color being integral with the material. The Midwest Molding & Manufacturing Company is molding the miniature motor.



A Versatile New Lever Motor

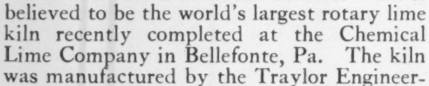
Doubtless, many a reader of this column has thought of many other uses to which pneumatically operated lever motors could be put if only they were not so restricted by their non-uniform operating characteristics. "At long last," there is a new lever motor on the market which is reported to have been designed and constructed specifically to overcome the traditional shortcomings of this type of device, giving it a much broader field of application.

This new product, manufactured by the Taylor Instrument Companies, Rochester, N. Y., is known as the Motosteel Evenaction Lever Motor. Its outstanding features include: All-steel welded construction—same as the recently announced Motosteel Diaphragm Valve—for maximum strength, lightness of weight, and permanency of alignment.—Precision operation characteristics which insure a uniform relation between the air pressure applied to its diaphragm motor and the resulting lever travel throughout its stroke.—Practically free from hysteresis: A deeper diaphragm with larger area gives greater power and smoothly modulated action. Ball bearing roller bearings guide the full stroke of the push rod. The lever is pivoted in phosphor-bronze bushings which are alignment-reamed in same manner as automobile engine bearings.—A number of take-off holes are provided throughout the length of the lever so that the force or travel of the motor may be adjusted.—Power of either up-stroke or down-stroke can be increased or decreased by spring adjusting nut.—The lever action can be reversed by substituting another lever and transposing the fixed and movable pivots.—Limit stops are provided for both up-stroke and down-stroke.—Base is drilled for mounting on floor, wall or ceiling, making possible an infinite number of mounting positions. Works equally well in all positions.—Three sizes of lever motors; in terms of maximum damper areas which can be accurately positioned—25 sq ft, 50 sq ft, 120 sq ft. When the Taylor Valv-Precisor or Dubl-Response Control Unit is operated in conjunction with any of these three motors, these damper areas may be increased appreciably.—May be operated by remote manual control, by an electro-pneumatic switch, or by a pneumatically operated controller. It also may be operated in parallel with a diaphragm valve or other pneumatic equipment, if desired.

These design and operating features recommend this new lever motor for the operation of dampers, lever operated valves, butterfly valves, electrical rheostat for variable speed motors, for the control of electrical equipment, or for the operation of any device by the conversion of pneumatic energy to linear or angular mechanical motion.

World's Largest Rotary Lime Kiln

Shown in the illustration below is what is believed to be the world's largest rotary lime kiln recently completed at the Chemical Lime Company in Bellefonte, Pa. The kiln was manufactured by the Traylor Engineering and Manufacturing Company, Allentown, Pa., and is entirely electric welded.



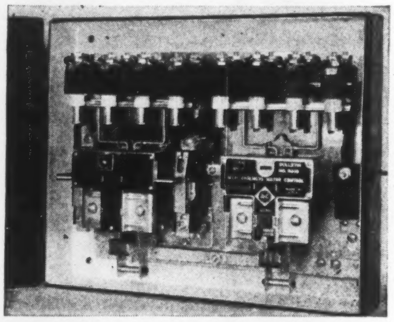
The kiln is 400 feet in length, consisting of a 300 foot zone, a 10 foot tapered zone, and a 90 foot preheating zone. Diameter of the pipe through the 300 foot zone is 8 feet 6 inches and 7 feet through the preheating zone. The kiln has a capacity of 200 tons of lime per day. The revolving load of the kiln is 1,000 tons when empty. This includes 568 tons of fire brick. Temperature of operation varies between 400 degrees at one end and 2100 degrees at the other. The rate of rotation is one revolution per minute. The kiln is driven by a 60 horsepower electric motor, driving through a gear reduction. The unit is also adapted for drive by a 110 horsepower gasoline engine which may be engaged by a clutch arrangement in case of electrical power failure.

This huge kiln is fabricated of $^1/_8$ inch steel plate throughout except under the tires where the thickness is one inch. There are a total of 21 arc welded sections in the kiln.

Application of the process which made possible the construction of this giant lime kiln is being furthered by The James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, which is conducting a $200,000 Award Program to encourage engineers and designers to study all types of products and structures so that the modern process of joining metals may be used in their construction.

Reversing Motor Starter

Allis-Chalmers Mfg. Company Condit Works, Boston, Mass., announces a new reversing motor starter, designated type AP-7-R, furnished for $7^1/_2$ H.P., 550 volts, or less. The starter consists of two type AP-7 motor starter units, mechanically interlocked so that either unit cannot be closed if the other is closed. The starter units are equipped with Ruptors. The Ruptors consist of enclosing chambers which confine and depotentiate the arc formed by circuit interruption. They greatly increase the interrupting ability of the contacts and form individual isolating barriers between contacts of opposite polarity. Other features are as follows: Large silver double break contacts—long life—no contact dressing needed; solenoid operated, vertical make and break—silent operation; unit construction—pole units consisting of individual molded bases mounted on a steel chassis—true contact alignment; enclosed temperature overload relays affording positive motor protection; undervoltage protection inherently provided.



New Elevator Bucket

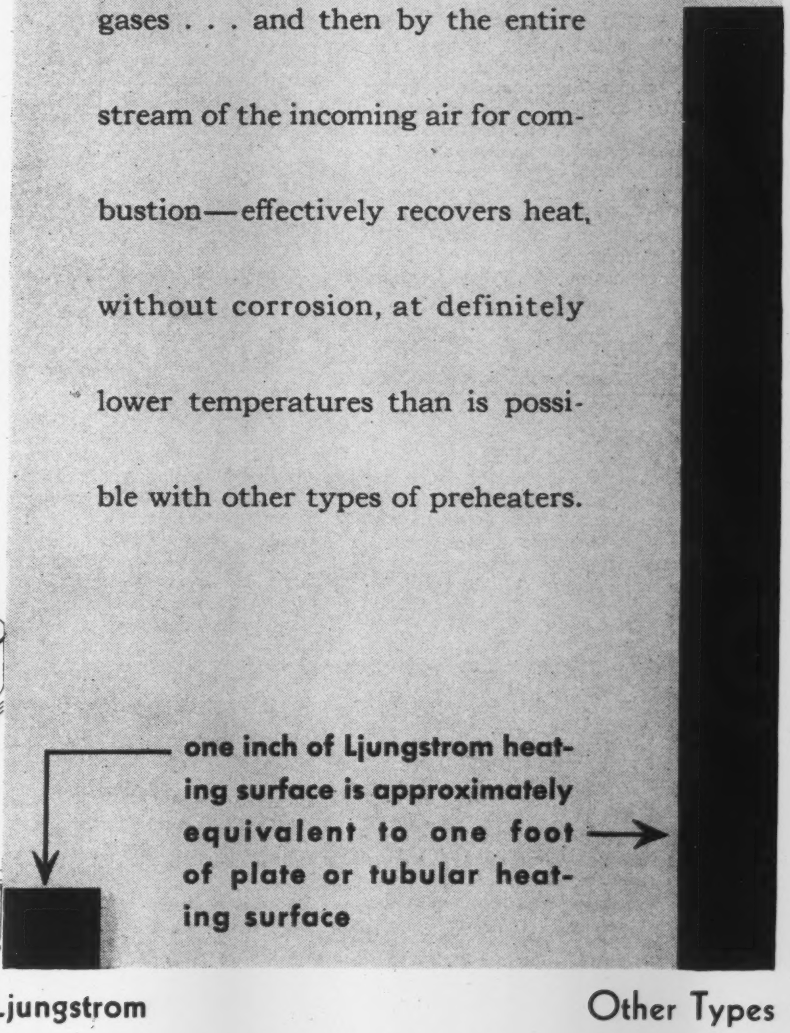
A notable improvement in the design and construction of Salem steel elevator buckets is announced by Link-Belt Co., 200 W. Pershing Rd., Chicago, Ill., probably the first radical change in 60 years. The new so-called Super Salem steel elevator bucket is reinforced at the digging lip, front corners and along back. Additional strength and greater resistance to abrasive wear and distortion, are claimed for this construction, without increase in bucket weight.

The reinforcing lip is an integral part of the metal body, folded over and spot-welded along the front edge. It is not a separate band. The back reinforcing plate also is spot-welded to the metal body. As no rivets are used, there are no rivets to wear away in service; to interfere with chain attachments;

Continued on Page 22

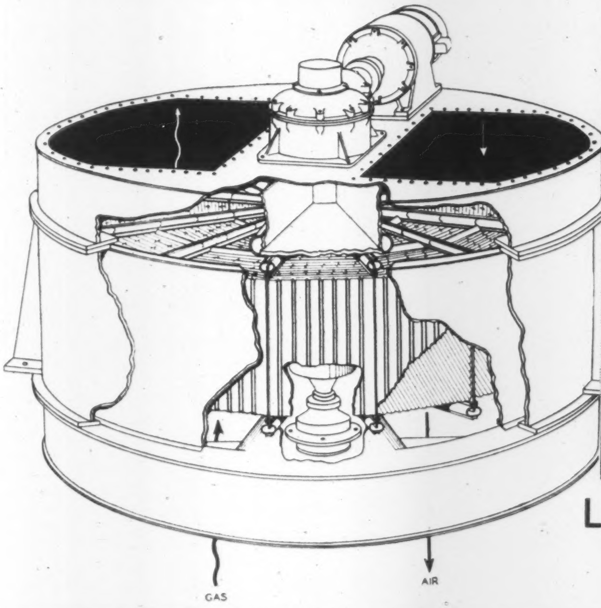
AIR PREHEATERS

The positive sweeping action of *all* of the heating surface of the Ljungstrom air preheater . . . first by the entire stream of the stack gases . . . and then by the entire stream of the incoming air for combustion—effectively recovers heat, without corrosion, at definitely lower temperatures than is possible with other types of preheaters.



one inch of Ljungstrom heating surface is approximately equivalent to one foot of plate or tubular heating surface

Ljungstrom



THE AIR PREHEATER CORPORATION

Under Management of THE SUPERHEATER CO.
60 East 42nd Street New York, N. Y.

A—1160

Continued from page 20

or to damage the elevator belt. It is unnecessary to use washers on the bucket attachment bolts, since the entire back of reinforcing plate presents a flat, smooth surface.

The construction of the new bucket is such as should insure smooth pick-up in the boot and free discharge of material at head of elevator. Super Salem buckets, made in $2^{1}/_{2}'' \times 2^{1}/_{2}''$ to $30'' \times 8''$ size, are interchangeable with the old, and in No. 24 and No. 18 gauge are said to be comparable to "heavy" construction of the conventional standard Salem design. The new bucket can also be furnished in copper, brass, aluminum, Monel metal, or stainless steel.

A new 4-page illustrated Folder No. 1435, giving full information, with list prices is available.

• BUSINESS CHANGES

New Terry Representatives

The Terry Steam Turbine Co., Hartford, Conn., announces that effective July 1st they have appointed the following district representatives who will handle the sales of Terry turbines, reduction gears, turbo-generator units, etc.: Walter Cooke, 846 Baronne Street, New Orleans, La.; Cowles & Company, 509 Mercantile Building, Dallas, Texas; M. N. Dannenbaum Company, 202 Petroleum Building, Houston, Texas; W. V. C. Jackson, National Bank of Tulsa Building, Tulsa, Okla.

L. T. McGuire to Harnischfeger Corp.

L. T. McGuire, for 18 years with the Byers Machinery Company of Ravina, Ohio, as assistant sales manager, has recently entered the employ of the Harnischfeger Corporation of Milwaukee as Divisional Manager of the Large Excavator Division. His long experience in the sale of excavating machinery has made him well known to men in this field.

Minneapolis-Honeywell Appointments

E. B. Evleth, affiliated with the Minneapolis-Honeywell Regulator Co. for twelve years, has been appointed Vice President and General Manager of the Brown Instrument Co., a division of Minneapolis-Honeywell in Philadelphia. Mr. Evleth succeeded William J. Hajek who has taken a six months leave of absence before resumption of active duties in an executive capacity with the Minneapolis office of Minneapolis-Honeywell. C. L. Saunders, former regional sales manager at Chicago has been appointed to succeed Mr. Evleth as Resident Vice President in charge of the Midwest region for the Minneapolis-Honeywell Co. Charles C. Cochran, formerly of the Milwaukee office, has been transferred to Chicago to assist Mr. Saunders in all non-industrial sales activities throughout the entire midwest region of Minneapolis-Honeywell. John B. Banks has been transferred from Chicago to Milwaukee as district branch manager. O. B. Wilson, who has been manager of the industrial division of the Chicago office, will extend his activities over the entire midwest region.

New Departure Honors Men of Long Service

Three hundred twenty-five employees of the New Departure Division of General Motors Corporation enjoyed a banquet and an evening of good-fellowship on July 8th as guests of the management. All present had served twenty years or more with the company and were presented with gold service buttons designating the number of years of service. Those having served more than a quarter-century (123 in all) received Hamilton presentation pocket watches appropriately inscribed.

As was brought out by General Manager F. G. Hughes in his address to the gathering, the 325 present had accumulated over 8,000 years of experience in the manufacture of New Departure Ball Bearings. Emphasizing the small turn-over and the very satisfactory employee relations, Mr. Hughes further stated that the 8,016 New Departure employees at Bristol and Meriden, Connecticut, had an aggregate service record of 53,182 years, or an average per employee of 6.6 years.

Gibbons with Hancock Valve

The Hancock Valve Division of the Consolidated Ashcroft Hancock Company, Bridgeport, Connecticut, announces the addition of James A. Gibbons to its field sales organization. Mr. Gibbons will specialize on industrial power plant and public utility construction work. He comes to Hancock from The Peabody Engineering Corporation of New York City, manufacturers of combustion equipment, where for eight years he was in charge of all advertising, sales promotion and publicity on central power station and industrial plant engineering.

• LATEST CATALOGS

Flow Meters

A new 40-page catalog on Bristol's Electrical and Mechanical Flow Meters is available for distribution by The Bristol Company, 21 Bridge St., Waterbury, Conn. These instruments are for recording, integrating, controlling, and indicating the flow of steam liquids or gases.

Details are given regarding the new Electric Flow Meter and its operation, using Bristol's Metameter principle of telemetering. Also, complete information is included on Bristol's Mechanical Flow Meters. The publication contains useful engineering data for reference.

Turbine Powered Oil Tankers

The large bulk oil tankers built recently in this country have nearly all been powered with geared steam turbines. The MOBILOIL and the MOBILGAS, constructed by the Sun Shipbuilding & Dry Dock Company for the Socony-Vacuum Oil Company, are described in a pamphlet now being distributed by the De Laval Steam Turbine Co., Trenton, N. J. These ships are similar to the tankers "Socony-Vacuum" and "Magnolia," of the same company, and are sister-ships of the tankers "Pan-American" and "Pan-Amoco," of the Pan-American Petroleum & Transport Company, also built by Sun. They are of around 21,000 tons displacement, and make 12 to 14 knots. Steam is generated at around 400 lb. gage and 700° F., and the turbines develop a shaft horsepower on a consumption of about 0.6 lb. of bunker oil for all purposes. The pamphlet shows drawings of the propelling units and gives particulars which will be of interest to all who design, build or operate ships.

Flexible Metal Hose Application

With a profusion of unusually fine illustrations, the new catalog of the Chicago Metal Hose Corp., 1305 S. Third Ave., Maywood, Ill., tells a comprehensive picture-story of the how-when-and-where to use flexible metal hose to advantage. Technical data is given on the use of flexible metal hose for saturated steam and superheated steam, for the conveyance of fluids and chemicals, and numerous special uses such as vibration absorbers for compressors, pumps and turbines, compensators for high temperature pipe lines, equalizer connections for gas burning furnaces. Two distinct types of tubing, annular corrugation (Rex-Weld) and spiral wound (Rex-Tube) are treated comprehensively, providing a valuable reference guide to users of either or both of these types of tubing.

Insulating Brick

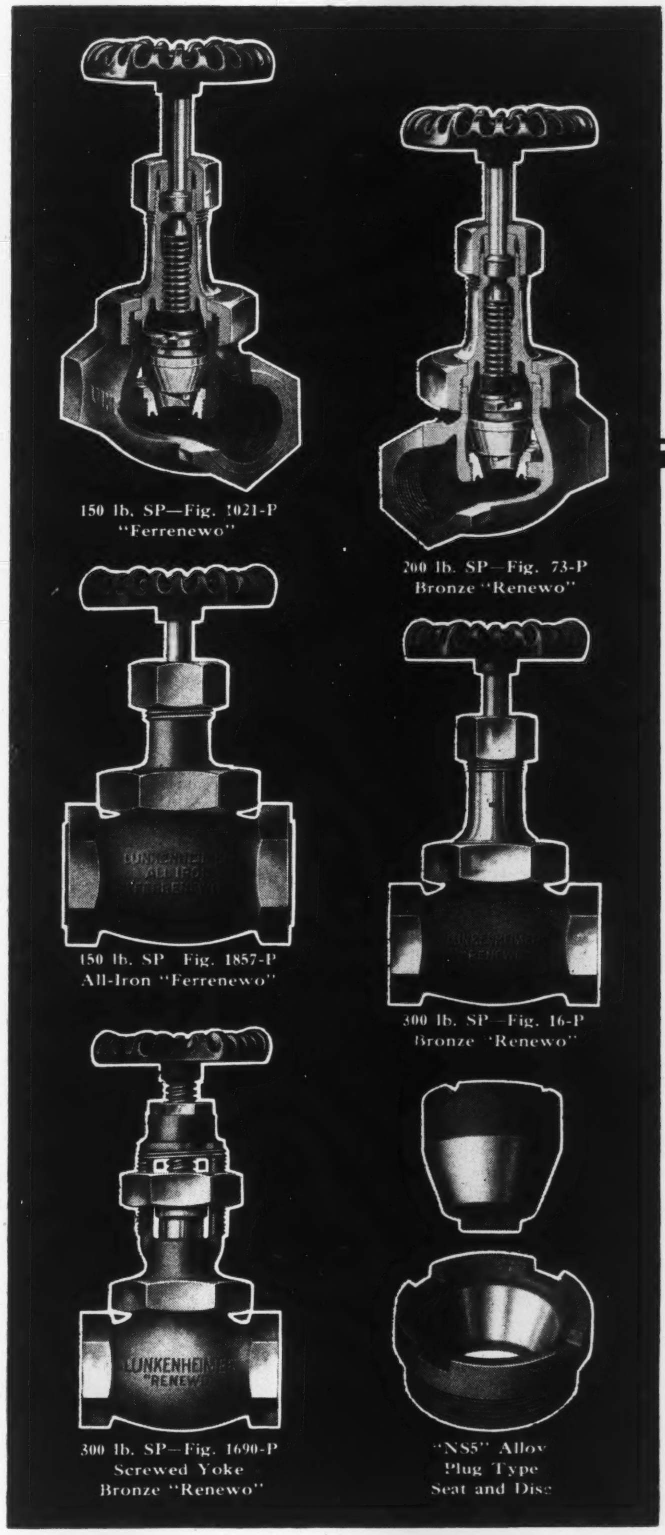
Twelve of the modern types of industrial furnaces for which the new JM-20 Insulating Brick has been developed are illustrated in a new piece of literature entitled, "Lower Furnace Operating Costs With Johns-Manville MJ-20 Insulating Brick." These furnace drawings show clearly the application of this new insulating brick to each of the twelve different types. One of the most useful features of this literature is a table giving the heat losses transmitted through fire brick walls bare and through fire brick walls insulated with JM-20 Brick. This table includes data on 27 different furnace wall constructions, representing virtually every practical combination of refractory and insulating brick. Also defined are the physical properties of this brick, which is designed for use behind refractory walls in furnaces and other types of high temperature, industrial equipment or for direct exposure at temperatures up to 2000 degrees Fahrenheit wherever there is no flame impingent, slag action, or mechanical abrasion. Copies are available free upon request to Johns-Manville, 22 East 40th Street, New York, N. Y.

Smoothare Welders

"The Arc-Welding of Tomorrow" is the title of the Smoothare Welder bulletin recently released by the Harnischfeger Corporation, 4497 West National Ave., Milwaukee, Wis. As modern in presentation as the subject it deals with, this book, No. W10, puts "in black and white" the advantages gained by the internally stabilized arc. It tells just what single current control means to the operator—what improvement it makes on the finished welded product. Clear action photos illustrate all the uses of many of the many Smoothare models—from

Continued on Page 24

To Meet the Trend Toward Wider Seat Faces



150 lb. SP—Fig. 1021-P "Ferrenewo"

200 lb. SP—Fig. 73-P Bronze "Renewo"

150 lb. SP Fig. 1857-P All-Iron "Ferrenewo"

300 lb. SP—Fig. 16-P Bronze "Renewo"

300 lb. SP—Fig. 1690-P Screwed Yoke Bronze "Renewo"

"NS5" Alloy Plug Type Seat and Disc

And to provide the proper valves for various pressures, Lunkenheimer offers a complete line of plug type seat and disc valves as illustrated, for steam pressures from 150 lb. to 300 lb.

The seats and discs have wide, uniform bearing contacts, accurately machined and carefully lapped to insure a perfect fit. The wide seating surface reduces the effect of wire-drawing and promotes longer service.

The "NS5" Alloy from which the seats and discs are made has exceptionally fine wearing properties, high corrosion resistance, will not gall, seize or lose its original hardness.

Install Lunkenheimer plug type valves and profit by the trouble-free, low-cost service you will experience.

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Buy QUALITY–Buy LUNKENHEIMER

• Keep Informed . . .

Continued from page 22

the vertical 75 and 100 ampere types to the 200, 300, 400 and 600 ampere horizontal models. Stationary and portable-trailer Smootharcs are also shown. It explains the importance of the arc characteristic to modern welding practice. A cutaway view is used to tell the story of Smootharc design.

Indicating and Recording CO₂ Meters

The Brown Instrument Co., 4496 Wayne Ave., Philadelphia, Pa., has just published a new catalog on Brown CO_2 Meters. This new catalog (No. 3005) covers the complete line of Brown indicating and Recording CO_2 Meters as well as the combined CO_2 and Flue Gas Temperature Recorders. A schematic diagram on pages 12–13 illustrates the operating principle of the Brown CO_2 Meter and describes the passage of the flue gas through the various units.

Boiler Tubes

The Babcock & Wilcox Tube Co., Beaver Falls, Pa., announces the publication of a new sixteen-page fully-illustrated booklet (Bulletin T-14) presenting, as the title implies, "Seven Facts About Boiler Tubes."

This booklet explains the effect of the manufacturing process upon the quality of a boiler tube, and answers many other important questions of interest to every buyer or user of boiler tubes.

Motorpump

Ingersoll-Rand Company, 11 Broadway, New York, N. Y., has just issued a new catalog describing its Cameron Motorpumps. These pumps are compact machines combining electric motor and centrifugal pumps in a single unit. Capacities range from 5 to 1000 gallons per min. for heads to 500 ft. Motor sizes range from $^1/_4$ to 40 HP.

New Fine Steels Book by Ludlum

Bearing the title, "Fine Steels by Ludlum," Ludlum Steel Company, Watervliet, N. Y., has recently published an attractive, pocket size book containing a number of new charts, conversion tables and other useful facts. Included are a Tool Steel Finder showing how to select the correct tool steel for a particular job; also a Stainless Finder accompanied by a table showing the comparative resistance of each grade of stainless to the various corrosive agents. Other data, gathered by means of physical tests and practical experience, cover Nitralloy and special products such as Hollow Drill Steel, Magnet Steel, Welding Rods for Hard Surfacing, etc. Address Ludlum Steel Company, Watervliet, N. Y., for a free copy of "Fine Steels."

New Screen Bulletin

Robins Conveying Belt Co., 15 Park Row, New York, N. Y., announces their new Bulletin No. 99-A covering the Robins Eliptex Screen.

Lincoln Arc Welded Design Chart Issued in Revised Form

The engineering drafting room chart brought out last fall by The Lincoln Electric Company, Cleveland, Ohio, to provide, in concise ready reference form, data necessary for producing arc welded designs is being revised according to announcement just received from the Company. The feature of the new chart will be the latest weld symbols adopted by The American Welding Society in May. Adoption of the new symbols by the Society is expected to go a long way toward simplifying welded design by making it possible to very clearly convey the information from the designer to the workmen. The new arc welding symbols, reproduced clearly and with complete explanation on the new chart, provide means of placing complete welding information on drawings.

The arc welded design chart, only one of its kind available, has been found extremely helpful in drafting rooms of companies whose products or work utilize arc welded construction. Data given on the chart includes, in addition to the latest approved and accepted symbols of The American Welding Society, illustrations and particulars regarding the 16 types of joints for arc welding; illustrated suggestions for better arc welded design; sketches explaining the nomenclature of welds; and a comparison of welded and riveted drawings. Additional information given on this chart, which will prove helpful in designing for arc welding, includes tables giving properties of base metals, weld metals, electrode metals for hard facing, length of fillet weld to replace rivets, and safe allowable loads for fillet welds in shear.

Copies of the chart can be obtained by writing The Lincoln Electric Company, Welding Engineering Department, Cleveland, Ohio.

Why Not Nibble It

If you have the problem of cutting odd shapes of ferrous and non-ferrous metals economically; or if your problem is the production of similar parts in quantities up to several hundred where cost is a big factor, you'll be interested in a new folder called "Why Not Nibble It." This eight-page folder issued by Andrew C. Campbell Division of American Chain & Cable Co. explains how Campbell Nibblers fit into the production cutting picture, and how in many cases they cut cutting costs. "Why Not Nibble It" will give you a new slant on Nibblers and their relation to your work.

Welded Piping Design

Complete handbook information on design and layout of piping for welded connections is contained in "Design of Welded Piping," a 200-page (6 × 9) booklet containing over 100 figures and tables, published by The Linde Air Products Company, New York. Subjects treated of interest to engineers are fundamentals of welded joint design; welding metallurgy; standard welded pipe connections; design data on welding cast iron, galvanized iron, stainless steel and non-ferrous piping; advantageous layout; fabrication and erection considerations; welded anchors and supports; and welding speeds. Features of interest to architects and draftsmen include standard joint designs; typical headers, expansion bends and riser connections; anchors and supports; a typical heating system layout showing symbols for welds; two sample time-saving specifications; and principal dimensions of pipe, flanges, and welding fittings.

Opportunities in Peru for American Industrial Machinery and Equipment

American manufacturers of industrial machinery and equipment interested in selling their products in Peru, are cordially invited to send the Peruvian Consulate their catalogs, price lists and full data in duplicate. Peru today offers exceptional opportunities for American industrial machinery and equipment. This Consulate is very much interested in promoting such trade. Address all communications to the Peruvian Consulate, 2314 Locust Street, Philadelphia, Pa.

COMING MEETINGS AND EXPOSITIONS

For the next three months

AUGUST

31– Sept. 3	**American Institute of Electrical Engineers,** Pacific Coast Convention, Spokane, Wash.
30– Sept. 3	**National Association of Power Engineers,** 55th Annual Convention and Mississippi Valley Power Show & Mechanical Exposition, Jefferson Hotel, St. Louis, Mo.

SEPTEMBER

6–10	**American Chemical Society,** Fall Meeting, Rochester, N. Y.
13–18	**American Institute of Mining & Metallurgical Engineers,** Joint Meeting A.I.M.E. and Canadian Institute of Mining and Metallurgy, Vancouver, B. C.
Wk. of 27	**American Gas Association Convention,** Cleveland, Ohio
28– Oct. 1	**Association of Iron and Steel Engineers,** Convention and Iron and Steel Exposition, Hotel Stevens, Chicago, Ill.
30– Oct. 1	**American Foundrymen's Association,** Mid-year technical sessions, Columbus, Ohio

OCTOBER

4–6	**American Society of Mechanical Engineers,** Fall Meeting, Lawrence Hotel, Erie, Pa.
6–8	**American Society of Civil Engineers,** Fall Meeting, Boston, Mass.
7–8	**American Institute of Mining & Metallurgical Engineers,** Petroleum Division, Oklahoma City, Okla.
11–15	**National Safety Council,** 26th National Safety Congress & Exposition, Kansas City, Mo.
14–16	**Society of Automotive Engineers, Inc.,** National Aircraft Production Meeting, Los Angeles, Calif.
14–16	**American Institute of Mining & Metallurgical Engineers,** Industrial Minerals Division, Fall Meeting, to be held jointly with Washington, D. C., Section, Washington, D. C., and College Park, Md., where the Eastern Experiment Station of the U. S. Bureau of Mines will be dedicated on the 15th.
18–22	**American Society for Metals,** National Metal Congress & National Metal Exposition, Auditorium, Atlantic City, N. J.
18–22	**American Welding Society,** Annual Meeting & Exposition, Traymore Hotel, Atlantic City, N. J.
18–22	**Joint Meeting of the A.S.M.E. Machine Shop Practice Division** with **American Welding Society** and **American Society for Metals,** Traymore Hotel, Atlantic City, N. J.
25–27	**National Machine Tool Builders Association,** Annual Convention, Hot Springs, Va.
27–29	**A.S.M.E Fuels Division** and **American Institute of Mining & Metallurgical Engineers Coal Division,** William Penn Hotel, Pittsburgh, Pa.

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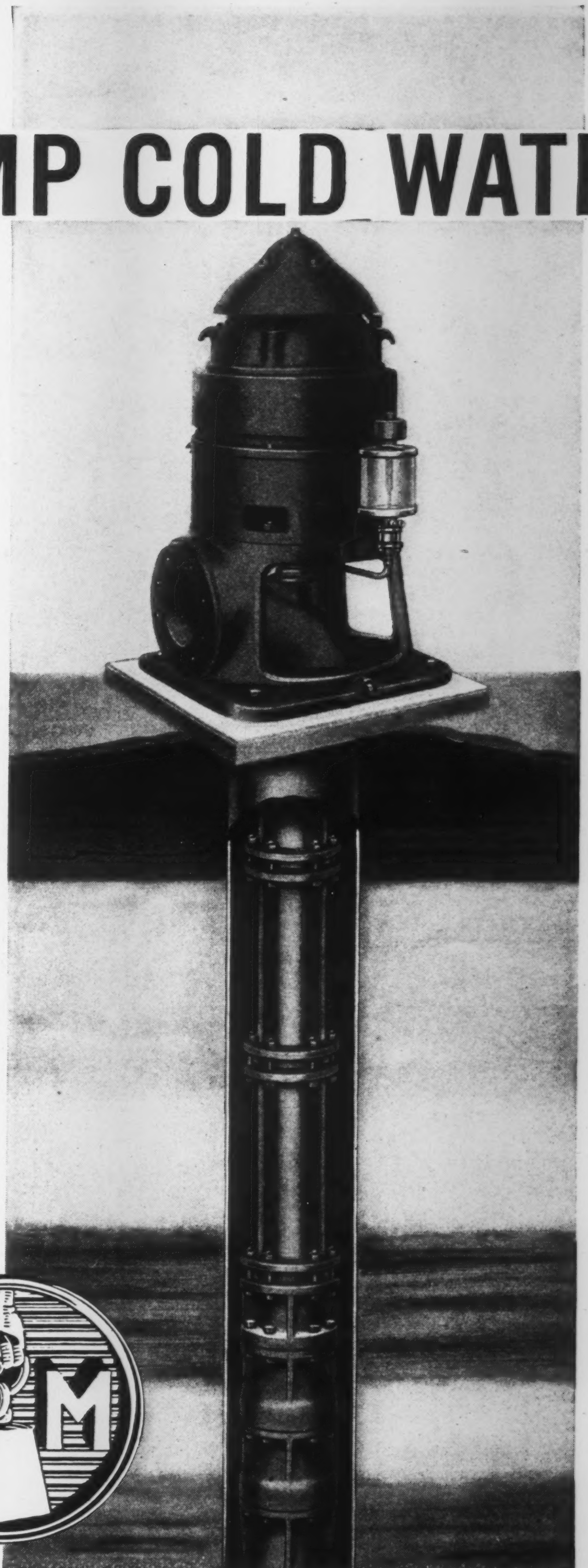
Before you choose any pump for this service, be sure to get your copy of Bulletin 6920-59. Address Fairbanks, Morse & Co., 900 South Wabash Avenue, Chicago, Illinois. 34 branches at your service throughout the United States.



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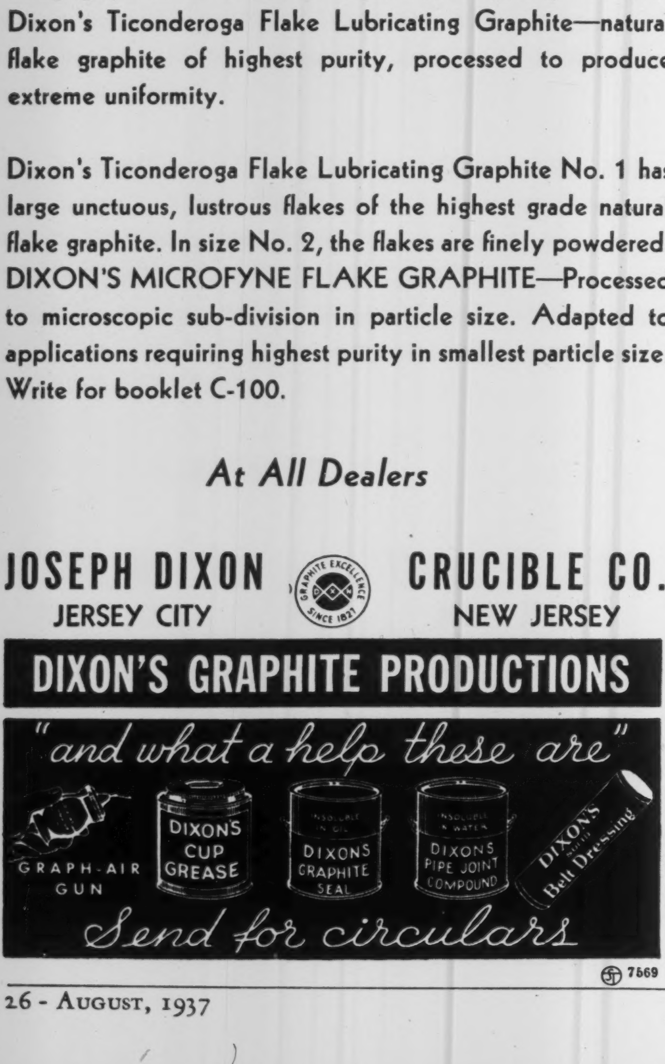

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The Standards COLUMN

News of Interest to Manufacturers

125 lb Cast-Iron Flanges and Flanged Fittings

There are few industrial standards that reflect in their make-up the evolution through which they have passed so well as the American Standard for Cast-Iron Pipe Flanges and Flanged Fittings rated for 125 lb steam service pressure at 450 F (B16a). The diameters of the flanges and the face to face dimensions of the fittings show by their lack of uniform variation that many compromises formed the basis of the original proposal when it was first drafted back in 1894.

However, the uniformity and interchangeability of the drilling templates for each size was the main objective of the first move toward standardization. The organization which cooperated with the A.S.M.E. in this venture was the National Association of Master Steam and Hot Water Fitters (now known as the Heating, Piping and Air Conditioning Contractors National Association). This standard was first known as the "A.S.M.E. Standard."

About 1910 a group of manufacturers of this product formed an organization called the Committee of Manufacturers on the Standardization of Fittings and Valves (now known as the Manufacturers Standardization Society of the Valve and Fittings Industry) and undertook the task of designing a completely standardized line of flanged fittings, including flange dimensions, center to face dimensions, and body metal thicknesses. This work was completed and published in 1912.

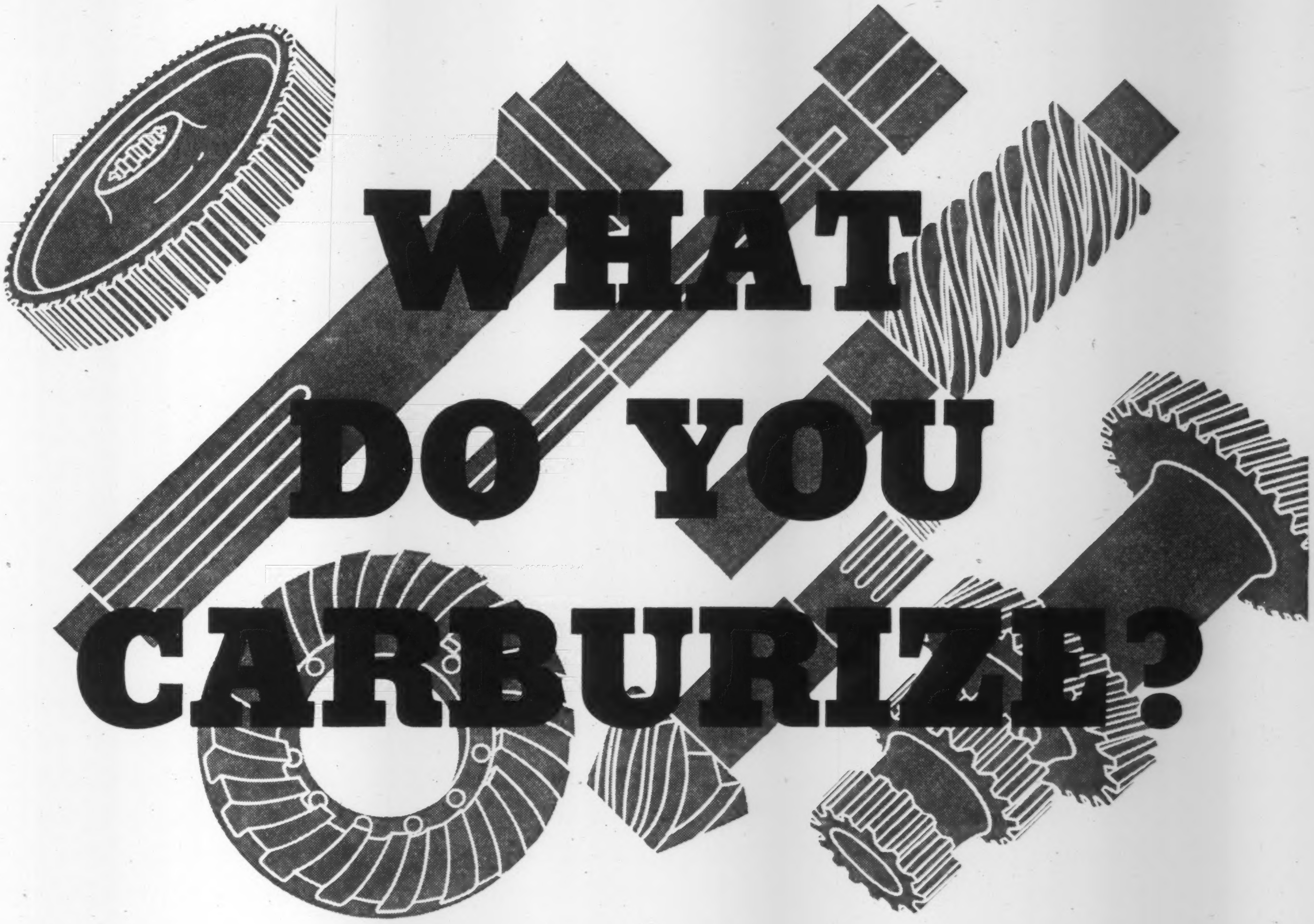
During the years 1912 to 1914 a Joint Conference Committee composed of representatives of the C.M.S.F.V. and the A.S.M.E. formulated a group of compromise standard dimensions of cast-iron pipe flanges and flanged fittings for use under working steam pressures of 125 and 250 lb per sq in. These standards were based on the 1912 edition of the "A.S.M.E. Standard" and the Manufacturers Standard adopted the same year.

The conference committee's report was completed in January, 1914, and revised in March, 1914. This revision was accepted at a meeting held in Washington which was attended by representatives of the U. S. Government, the A.S.M.E., the N.A.M.S.H.W.F. and the C.M.S.F.V. The A.S.M.E. adopted the report of this committee and thus the "American Standard for Pipe Flanges, Fittings, and their Bolting" became effective in 1914.

In 1921, following the organization of the American Standards Association, a fully representative sectional committee was formed to undertake the standardization of all types of screwed and flanged fittings. Dr. Collins P. Bliss became chairman of the general committee and nine subcommittees were formed to develop the original proposals for each standards project. The standard for 125 lb fittings was further revised by this committee and was approved by the ASA and published in February, 1928. A further revision and expansion of this standard is now in progress.

For further information—address

The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.



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If your carburizing requirements call for exceptional wear resistance plus good core properties—you can save money by standardizing on Chrome-Molybdenum carburizing steel.

This new carburizing steel has been developed as an answer to insistent demands for greater production economy in the face of rising costs.

It carburizes under ordinary shop conditions with minimum, uniform distortion. It takes a very hard, wear-resistant case. It develops good core properties. It anneals to quick machining hardness. And—it costs less than any other existing successful alloy carburizing steel.

Chrome-Moly has already solved some difficult problems. It is being used for a wide variety of applications. It will pay to investigate it fully—as an effective means of cutting your carburizing costs. We will gladly furnish complete details. Climax Molybdenum Company, 500 Fifth Avenue, New York City.

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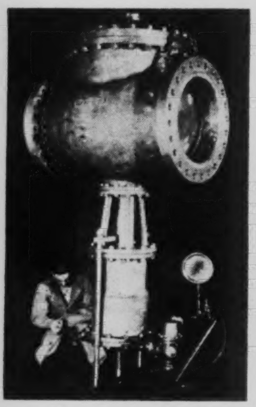
• *NEW EQUIPMENT*

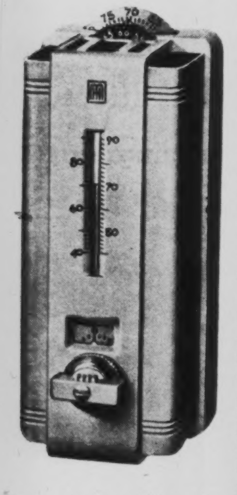
Edward Valve Line Enlarged



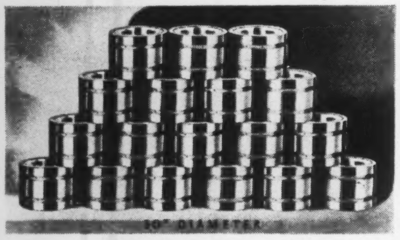
The Edward Valve & Mfg. Co., Inc., East Chicago, Indiana, has recently enlarged its already extensive line of bleeder line non - return valves. The illustration shows an oil-operated swing check valve, 24 in. size, for 200 lb steam service pressure. The valve acts as a freely operating swing check valve, or it may be closed automatically by oil pressure release through the 2 in. pilot valve shown in the lower right-hand corner of the picture. The gage and flexible hose line shown in the picture were used in connection with the operating test at the shop. The seating faces of seat and disk were Stellited and the seat was welded into the valve body. The assembled valve weighed nearly three tons.

New Minneapolis-Honeywell Thermostat

The Minneapolis-Honeywell Da-Nite Acratherm combines the Acratherm and the Time-O-Stat into one small, attractive thermostat. This is the only thermostat that offers in one instrument, manually lowered temperature, night or day, with its resultant fuel economy . . . automatic return, to the desired temperature level whenever wanted . . . and the accuracy of control provided only by Minneapolis-Honeywell "Heat Acceleration." The Da-Nite Acratherm is equipped with a black setting wheel and winding knob—both on the same shaft—presenting the simplest of adjustment features and eliminating the necessity of arithmetical calculations. The temperature setting can be made at any point as low as 45° by simply moving the indicator to the desired lower temperature scale. The thermometer is recessed to guard against breakage. A dial lock screw is furnished when specified to prevent tampering with the temperature setting, and a locking device for the cover is available at no additional cost. The Da-Nite Acratherm is furnished with a detachable wall plate for mounting and an adjustable differential. 55 to 85° F. is the day scale range of the Da-Nite Acratherm and 45 to 75° F. is the night scale. The list price of the Da-Nite Acratherm, however, is only ten dollars more than the original Acratherm. The Da-Nite Acratherm is made by the Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.



Large Bantam Bearings

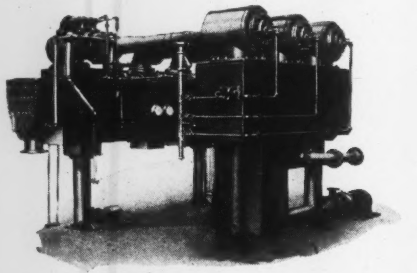


The eighteen bearings shown here, each 18" x 30" x $20^3/_4$" long, are a partial shipment of an order for 110, 4 row tapered roller bearings just being completed and shipped by the Bantam Bearings Corporation, South Bend, Indiana. Each of these weighs 2,300 pounds, the total weight of those shown being 41,400 pounds, and the total weight of the order 253,000 pounds.

Water Vapor Refrigeration

The application and advantages of Steam-Jet Coolers (Stem-jet water-vapor refrigerating units) is the subject of bulletin number 9143, recently published by Ingersoll-Rand Company. This ingenious type of refrigeration is of particular interest because of features which make it especially desirable for air conditioning and industrial applications under a diversity of conditions.

Water is cooled by direct evaporation under high vacuum maintained by steam jet boosters. The water itself is the only refrigerant in the system. Refrigerant replacement cost is completely eliminated. The equipment may be operated successfully by unlicensed and unskilled personnel and with a minimum of attention. Maintenance costs are extremely low. Only the auxiliary centrifugal pumps have moving parts and vibration and noise are consequently slight. The special design of evaporator and control gives flexibility and high efficiency under all loads.

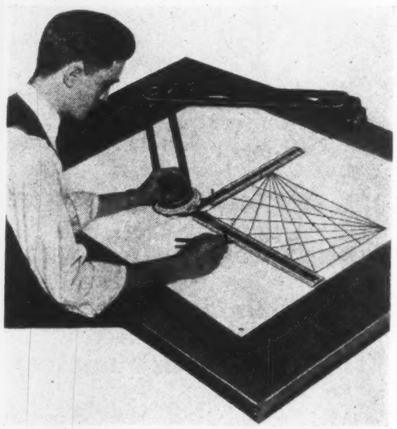


The unit is low in first cost and is especially adaptable for air conditioning in public buildings, factories and on shipboard and for industrial processes requiring cold water wherever steam and condensing water are available. Steam-Jet Coolers are built in sizes from 10 tons of refrigeration upward for operation at steam pressures as low as 2 lbs. A companion line of centrifugal water-vapor refrigerating units, using a centrifugal compressor instead of a steam-jet booster, is available for electric motor or steam turbine drive in sizes of 100 tons of refrigeration or larger.

Examples of Steam-Jet Cooler applications together with rating curves and details of construction and operation, are presented in the bulletin, number 9143, which may be obtained from Ingersoll-Rand Company, 11 Broadway, New York, N. Y., or any of their branch offices.

New Drafting Machine Has One Hand Control

A new drafting machine, controlled entirely by the left hand, is announced by Keuffel & Esser Co. of Hoboken, N. J. The device is designed to replace all the tools handled most frequently by a draftsman, and has many improvements and refinements that bring greater accuracy and efficiency to the drafting board. It will be known as the "K & E Paragon Drafting Machine."



The "Paragon" machine consists of a jointed arm of aluminum alloy, having a protractor head fitted with two scales at 90 degrees. Parallel motion is maintained by tempered steel bands under constant tension, concealed within the arm sections. All moving parts turn on fine quality precision ball bearings for ease and uniformity of operation.

The protractor head allows the scales to be set and locked at any angle, to move freely in angular displacement, or to stop automatically at every 15 degrees. Variations of the scale angle are made by means of a locking and stop mechanism operated by a single lever under the left thumb of the operator, so that the entire device can be operated and controlled by the left hand only.

Interchangeable scales may be quickly attached or removed to permit the use of any required scale combination. In addition to the conventional white-edged scales, a series of special scales, made of aluminum alloy with hardened black surface and white

Continued on Page 18

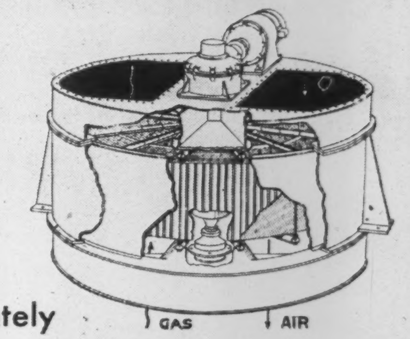
AIR PREHEATERS

THE *Accepted Standard*

For HIGH-HEAT Recoveries

... Ljungstrom

Ljungstrom Air Preheater for Vertical Gas and Air Flow



- Occupies less space.
- Weighs less and saves on supporting structure.
- One inch length of its heating surface is approximately equivalent to one foot length of plate or tubular heating surface.
- The heating surface is grouped for economy and ease of replacement. Designed for efficiency—accessibility—replacement without disturbing any other part of unit.
- Higher air temperatures are obtainable.
- Lower gas temperatures are obtainable.
- If operating conditions are conducive to corrosion, Ljungstrom combats it most effectively at lowest cost.

Ljungstrom offers to power plant owners and operators, the most advanced type of air preheater, and on such an economic basis as to make it the most popular and most economic air preheater for high heat recoveries.

THE AIR PREHEATER CORPORATION

Under Management of THE SUPERHEATER CO.
60 East 42nd Street New York, N. Y.

A-1161

• Keep Informed . . .

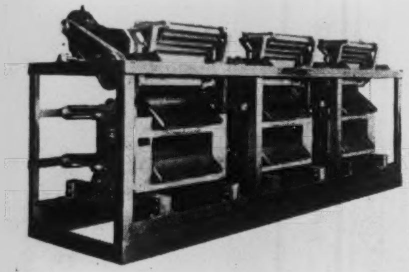
Continued from page 16

graduations and numbers, are available for use with the "Paragon" machine. The aluminum scales are said to be impervious to atmospheric changes, and extremely serviceable because of their resistance to wear and rough handling.

The K & E Drafting Machine is offered in two models: a standard type, with a spring counterbalance to prevent accidental motion, for use on drawing boards at any angle up to fifteen degrees; and a vertical type, with a weighted counterbalance, that can be used in any position of the board from horizontal to vertical.

Stearns Magnetic Separators

The Stearns Magnetic Mfg. Co., 614 S. 29th St., Milwaukee, Wis., manufacturers of an extensive line of magnetic separation equipment, has recently shipped one of the largest of its Type "K" magnetic separators that has ever been built.

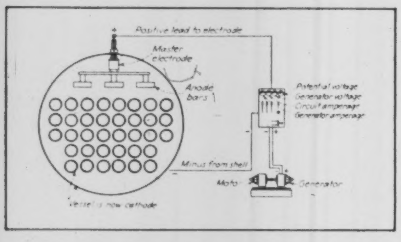


This machine is a 90″ three field gravity induction type separator and has been shipped to an Eastern silica sand producer for use in purifying this sand from iron particles and give it highest rating in the fine glass processing industry.

Bulletins on Type "K" Magnetic Separators and other magnetic separation equipment are available.

Combating Scale and Corrosion by Electrolysis

Greater heat transfer efficiency in steam power plants, and substantial reductions in maintenance costs, are now being obtained by many operators through the use of the Kirkaldy System which effectively combats and prevents corrosion, scale and slime. Corrosion in metallic water containers is an electrochemical phenomenon. Each steam power plant unit, such as boilers, heaters, condensers, and the like, may be regarded as a storage battery, or rather, as an electroplating tank, with the water acting as the electrolyte.



With the Kirkaldy System installed, special corrosible electrodes are introduced into the contained water, and the polarity of the power plant units is *reversed*. Power plant units, having normally positive polarity, are now cathodic, or negative. At the positive pole, or anode, are the corrosible electrodes—martyrs deliberately sacrificed to corrosion so that the vessel itself may endure. This simple yet unique electrical arrangement accomplishes more than corrosion prevention: scale and slime cannot adhere to the cathodic walls of the power plant units.

The equipment consists of a number of suitable anodic bars or discs (mild steel or carbon), mounted within but electrically insulated from the power plant units; an electric motor generator; an automatic current controller; a control switchboard; and the necessary wiring to complete the circuit. The operation is automatic, and the voltage required is only 5 to 10 volts, depending on conditions. Current consumption varies from 0.4 kwh per day per 1000 sq. ft. of protected surface with salt water, to 2.0 kwh per day per 1000 sq. ft. with fresh water. Corrosion is reduced up to 98.8%, and expensive scale and slime removing operations replaced by infrequent flushing out of the residue. The equipment is manufactured by Electrolytic Metal Protection, Inc., 247 Park Avenue, New York, N. Y., of which W. A. Bary is the president; B. G. Brolinson, vice president; and Alexander Kirkaldy, the inventor of the process, technical consultant.

• *BUSINESS CHANGES*

J. P. Boore Assist. General Sales Mgr.

The Babcock & Wilcox Tube Company, Beaver Falls, Pa., announces the recent appointment of J. P. Boore, assistant general sales manager. Mr. Boore has had broad experience in the production and merchandising of seamless steel tubes and pipe. For several years he was vice president of Summerill Tubing Company, and for twenty years prior to that he was associated with the Pittsburgh Steel Company in various capacities in the production and sales departments.

Johns-Manville Announces Promotions to Form New Manufacturing Divisions

Seven promotions, including the election of three new vice presidents of the Johns-Manville Products Corporation, were announced on August first by Lewis H. Brown, president of Johns-Manville Corporation. The new vice presidents of the J-M Products Corporation, a subsidiary controlling most of the Company's wide-spread manufacturing and mining activities, are A. R. Fisher, formerly manager of the Company's largest factory at Manville, N. J.; J. P. Kottcamp, who has been the manager of the key Mid-Western factory at Waukegan, Ill.; and Alexander Cromwell, currently manager of the Pacific Coast manufacturing operations.

These men have general supervisions over newly-established manufacturing districts, each of which includes five factories. Mr. Fisher has been assigned the Eastern District, which includes plants at Asbestos, Province of Quebec; Nashua, N. H.; Oswego, N. Y.; Manville, N.J.; and an insulating board plant, not yet constructed. The Central Division, consisting of plants at Waukegan, Ill.; Alexandria, Ind.; Richmond, Ind.; Newell, West Virginia; and Marrero La., is under Mr. Kottcamp, whose headquarters remain at Waukegan.

Mr. Cromwell is in charge of manufacturing activities on the Pacific Coast at Lompoc, Pittsburg, Redwood City, Los Angeles and Watson, California. J. E. Begert, formerly head of the Cost Reduction Department at J-M Headquarters in New York City, has succeeded Mr. Fisher as manager of the Manville plant. At the Waukegan factory K. W. Huffine, formerly manager of the Alexandria plant, has been named to succeed Mr. Kottcamp as manager. H. J. O'Brien, formerly superintendent of the Rock Wool Department at Manville factory, has become manager of the Alexandria plant. W. Kelty, who was Assistant to Mr. Begert in the Cost Reduction Department, succeeds him as manager of that department.

Coincident with the establishment of these three new manufacturing districts, Johns-Manville has consolidated its mining operations at Asbestos, Province of Quebec, and Chrysotile, Arizona, to form the Asbestos Division, which is under the charge of C. H. Shoemaker, vice president of Canadian Johns-Manville Company, Ltd.

New Lincoln Sales Office in Sacramento

The Lincoln Electric Company, manufacturer of arc welding equipment, Cleveland, Ohio, announces it is now providing arc welding users in Sacramento and the central valley of California, complete arc welding sales and engineering service. The Lincoln Sacramento representative is Mr. William F. Fischer, address—1241-32nd Street.

Mr. Fischer has had over five years' extensive experience in the welding field. His broad practical knowledge obtained in applying and using welding in manufacture, construction and maintenance, is available to welding users in the central valley. Although Mr. Fischer works out of the San Francisco office under the management of S. H. Taylor, Jr., he is stationed in Sacramento.

• *LATEST CATALOGS*

Link-Belt Cast Iron Pulleys

A new 8-page illustrated list price Book No. 1622 has been completed by Link-Belt Company, Chicago, on the subject of cast iron pulleys for power transmission, giving pertinent data on solid and split, single and multiple arm machine-molded pulleys, with and without rubber lagging.

Building Better Pipe Lines

Latest information on the construction of pipe lines by electric welding for transportation of oil, gas and water is contained in a new bulletin just published by The Lincoln Electric Company, Cleveland, Ohio.

The new bulletin, entitled, "Building Better Pipe Lines Faster at Less Cost by Shielded-Arc Welding," is profusely illustrated with photographs of pipe lines under construction by electric welding. A brief foreword reviews the progress of electric welding in pipe line construction from 1928 when the first major pipe line was electric welded up to the present time The steadily increasing use of the process is illustrated by means of a chart showing the percentage of electric welded lines to the total lines built from the year 1928 to 1936 inclusive. This chart indicates that 75% of the lines constructed in 1936 were electric welded compared with approximately 10% for the year 1928. Following the foreword, there

Continued on Page 20

ROLLED STEEL CONSTRUCTION . . . *Every one!*

And that means the right *steel in the* right *place to do a more efficient job*

HERE are four interesting products recently fabricated from various USS Rolled Steels which emphasize the outstanding advantage of rolled steel construction—the fact that *you can pick steel to fit your job.*

To machine designers, fabricators, foundries and welderies, we offer a wide variety of "staple" and "special" steels, in sizes and shapes most suitable for economical fabrication.

USS High Tensile Steels to carry high unit stresses and reduce weight to a minimum.

USS Abrasion-Resisting Steel to reduce abrasive wear and cut down replacements.

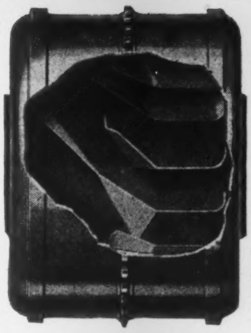
USS Steel for Low Temperature Service to provide high impact strength at low temperatures.

Special analyses of USS Carilloy Alloy Steels to carry tremendous bearing pressures safely.

USS Heat-Resisting Steels to endure temperatures disastrous to other metals.

USS Stainless Steels to resist corrosive environments.

Write us freely about any problem which you feel rolled steel design — or these special steels — might help you solve.



(Above) 30 cubic yards at one gulp. USS MAN-TEN rolled steel welded in this heavy duty dipper saves thousands of pounds of weight that are converted into increased dipper capacity.

(Left) USS Stainless Steel, because it should last indefinitely and will not contaminate most corrosive products, is often the best choice for welded chemical machinery like this power-agitated autoclave.

(Right) Abrasion-Resisting Steel in this concrete mixing drum withstands destructive pound and grind. Reduces breakage. Ensures long life.

Welded rolled steel and steel castings ideally combined in this cone-type uncoiler for tin plate mill, make this unit strong, light, rigid—eminently practical and economical.

AMERICAN STEEL & WIRE COMPANY, *Cleveland*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
NATIONAL TUBE COMPANY, *Pittsburgh*
TENNESSEE COAL, IRON and RAILROAD COMPANY, *Birmingham*

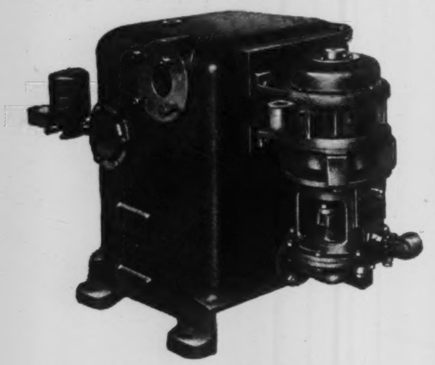
United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

Continued from page 18

is a short explanation of the modern shielded arc process of electric welding together with a summary of tests of pipe welds made by this process. Reasons for the lower cost of pipe line construction with electric welding are indicated, by explanation of modern pipe line construction by the method. Data is given in tabular form on important aspects of welding of pipe lines. Tabulated data include: recommended sizes of electrode for pipe line welding, average speed for shielded arc welding, recommended amperage and voltage for various sizes of rod, pounds of electrode per weld and recommended spacing for pipe. That electric welding has become established procedure for construction of pipe lines is indicated by two full pages in the bulletin devoted to the specifications developed by one of the largest pipe line construction companies for the arc welding of oil, gas and water pipe lines. The specifications apply to pipe connected by a three bead joint without liner, a two bead joint with liner and joint in water pipe over 36 inches in diameter.

Motorpump Condensate Return Units



New Bulletin No. 1972-B illustrates the Cameron Motorpump condensate return unit and shows many of its applications. The bulletin also contains information regarding sizes and capacities. Copies may be obtained from Ingersoll-Rand Company, 11 Broadway, New York, N. Y., or any branch office.

Larger Hard-Facing Booklet

A new and more complete edition of the booklet, "Hard-Facing with Haynes Stellite Products," is now being issued by Haynes Stellite Company, Kokomo, Indiana, a Unit of Union Carbide and Carbon Corporation. This booklet describes well over 500 money-saving applications of the hard-facing process.

This new edition is the fourth printing since the booklet was originally published a little more than three years ago. Over 35,000 copies have already been distributed. New sections present information concerning special Haynes Stellite J-Metal cutting tools and an improved welding technique for fabrication of equipment employing the corrosion-resistant Hastelloy alloys. A number of examples of hard-facing automotive and aircraft valves and valve seat inserts, and the use of Haynes Stellite trim for high-temperature, high-pressure steam valves, are now also described in detail.

New Deep-Well Turbine Pump Bulletins

Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill., announces two new bulletins which describe the Fairbanks-Morse line of deep-well turbine pumps with enclosed impellers. Bulletin 6920 deals with oil lubricated units used for most applications; Bulletin 6920R covers water lubricated units, which are used where the water must be kept pure and clean and oil lubrication is not permissible.

Both types, oil and water lubricated, are available in sizes from 4 to 16 in. and in capacities from 10 to 2300 gal. per min. with lifts ranging to 400 ft. They are efficient pumping units, requiring a minimum of power, and have a record for low maintenance cost. Heads can be furnished for belt, gear, combination motor and belt, and combination motor and gear drives.

Where the drive is a Fairbanks-Morse electric motor, Diesel or gas, gasoline or kerosene engine, the user enjoys the advantage of undivided responsibility for successful operation of both pump and drive.

New Morse Silent Chain Engineering Data Book

The Morse Chain Co. Ithaca, N.Y., announces their 1937, Silent Chain Engineering Data Book just off the press. In this 20-page booklet has been gathered detailed information that plant engineers and production men most frequently require in plan and specifications for Silent Chain drives.

A partial list of the new book's contents include horsepower tables, explanation of the different types of Morse Silent Chains and their applications, layouts of typical shoes and idlers, sprocket data, directions for cutting sprockets, how to calculate chain length, special sprockets and their uses, chain cases and methods of oiling. It is profusely illustrated with photographs, detailed drawings, and special graphs.

Bakelite Materials

People often ask: What is Bakelite?—In answer to this question Bakelite Corp., 247 Park Ave., New York, N.Y., have just prepared a booklet, "The Versatile Service of Bakelite Materials" in which they have given the story of the development of various Bakelite resinous materials, their general characteristics, their properties and their applications.

New Nickel Cast Iron Data Bulletin

Metallurgists working unceasingly to discover new and useful combinations of elements have been no less diligent in efforts to improve structural and mechanical properties of long established materials. As a natural development, metals whose usefulness has heretofore had definite limitations, have had their industrial importance greatly enhanced.

Cast iron is one of the most interesting examples of this trend. Until recent years used primarily for equipment parts of great size requiring little strength, hardness, or resistance to heat, wear and corrosion, its uses are now marked by their diversification. Modern foundry procedure, employing heat treatment, alloying and closer metallurgical control, has done much to assure the improvement of all properties listed and, by improving uniformity of properties and machinability, has decreased rejections by foundry, machine shop and other inspectors.

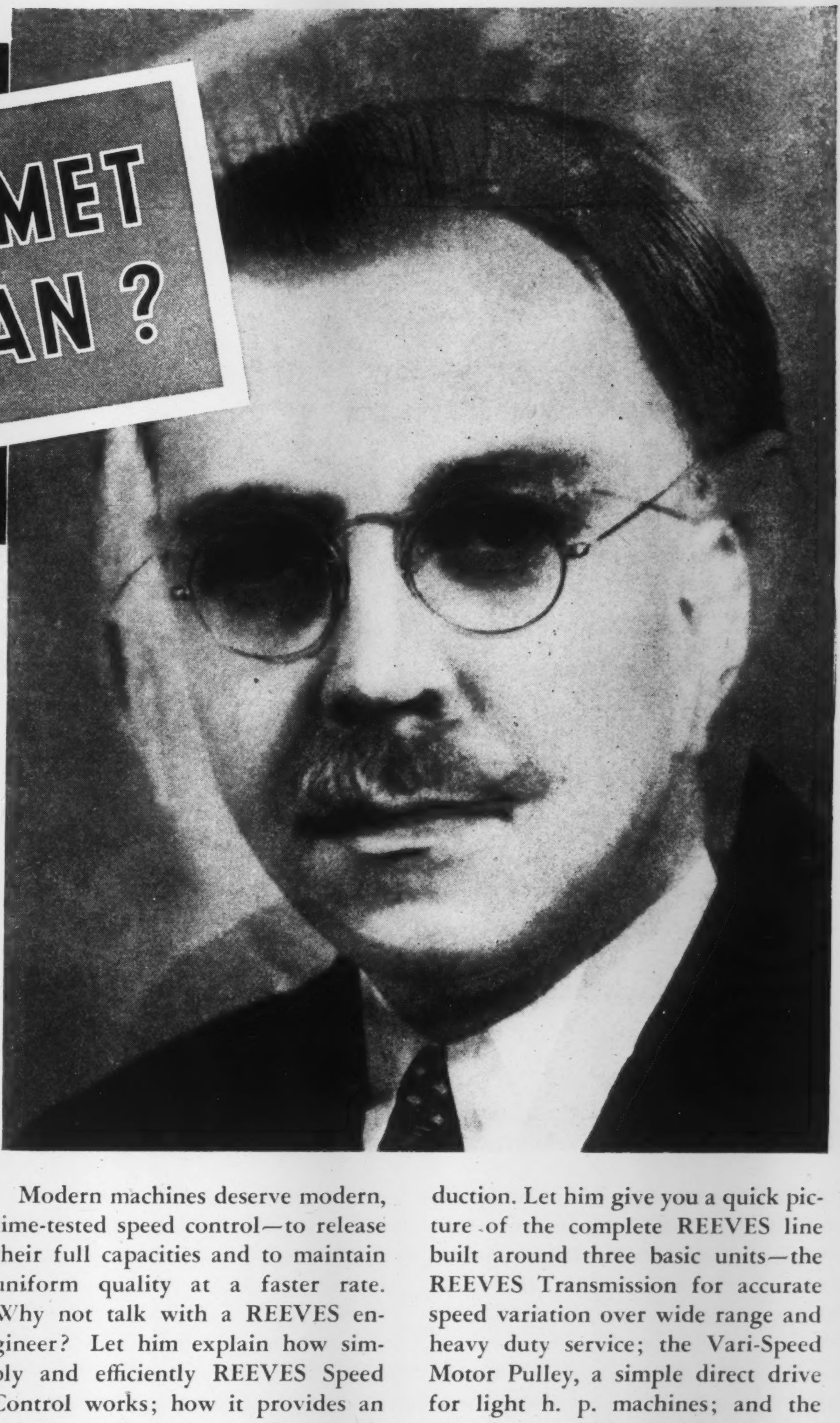
A new bulletin, just issued by the International Nickel Co., 67 Wall St., New York, N. Y., deals with the improvement of cast iron by heat treatment. Its scope is necessarily limited to broad principles and prominent industrial applications. Current materials problems may be submitted to them for recommendations of their development and research staff.

COMING MEETINGS AND EXPOSITIONS

For the next two months

SEPTEMBER	
6–10	**American Chemical Society,** Fall Meeting, Rochester, N. Y.
13–18	**American Institute of Mining & Metallurgical Engineers,** Joint Meeting A.I.M.E. and Canadian Institute of Mining and Metallurgy, Vancouver, B. C.
20–22	**American Gear Manufacturers Association,** 20th Semi-Annual Meeting Spink-Wawasee Hotel, Lake Wawasee, Ind.
Wk. of 27	**American Gas Association Convention,** Cleveland, Ohio
28–Oct. 1	**Association of Iron and Steel Engineers,** Convention and Iron and Steel Exposition, Hotel Stevens, Chicago, Ill.
30–Oct. 1	**American Foundrymen's Association,** Mid-year technical sessions, Columbus, Ohio
OCTOBER	
4–6	**American Society of Mechanical Engineers,** Fall Meeting, Lawrence Hotel, Erie, Pa.
6–8	**American Society of Civil Engineers,** Fall Meeting, Boston, Mass.
7–8	**American Institute of Mining & Metallurgical Engineers,** Petroleum Division, Oklahoma City, Okla.
9	**Joint Engineers Meeting** to be held during Anthracite Week in Scranton, Pa. It will be sponsored by the local sections of **The American Institute of Mining and Metallurgical Engineers,** the **American Institute of Electrical Engineers,** the **American Society of Mechanical Engineers,** and the **Chambers of Commerce in the Anthracite Field.**
11–15	**National Safety Council,** 26th National Safety Congress & Exposition, Kansas City, Mo.
14–16	**Society of Automotive Engineers, Inc.,** National Aircraft Production Meeting, Los Angeles, Calif.
14–16	**American Institute of Mining & Metallurgical Engineers,** Industrial Minerals Division, Fall Meeting, to be held jointly with Washington, D. C., Section, Washington, D. C., and College Park, Md., where the Eastern Experiment Station of the U. S. Bureau of Mines will be dedicated on the 15th.
18–22	**American Society for Metals,** National Metal Congress & National Metal Exposition, Auditorium, Atlantic City, N. J.
18–22	**American Welding Society,** Annual Meeting & Exposition, Traymore Hotel, Atlantic City, N. J.
18–22	**Joint Meeting of the A.S.M.E. Machine Shop Practice Division with American Welding Society and American Society for Metals,** Traymore Hotel, Atlantic City, N. J.
25–27	**National Machine Tool Builders Association,** Annual Convention, Hot Springs, Va.
27–29	**A.S.M.E Fuels Division** and **American Institute of Mining & Metallurgical Engineers Coal Division,** William Penn Hotel, Pittsburgh, Pa.

HAVE You MET THIS MAN?



This is a composite photograph of a REEVES Speed Control Engineer. He represents the combined features of 84 REEVES representatives who are located in every leading industrial center in the United States.

This man is at your service—without charge—to help you apply speed control to the machines you build. He is factory trained. He has an average of 17 years' speed control experience in the field. He has engineered an average of 2100 Speed Control applications covering practically every type of driven machine. He gives his entire attention to this specialized work.

To meet all problems in machine speed adjustability, REEVES offers not only the most complete line of modern speed control equipment, but what is equally important the experienced engineering skill to get *results.*

Today the work of a REEVES engineer may involve speed control for a boring mill to machine huge pipe lengths, ranging from 8 to 30 feet in diameter; tomorrow it may be a machine to polish diamonds. But with his wide experience and the complete line of REEVES Speed Control equipment to draw on, the customer always gets the correct application.

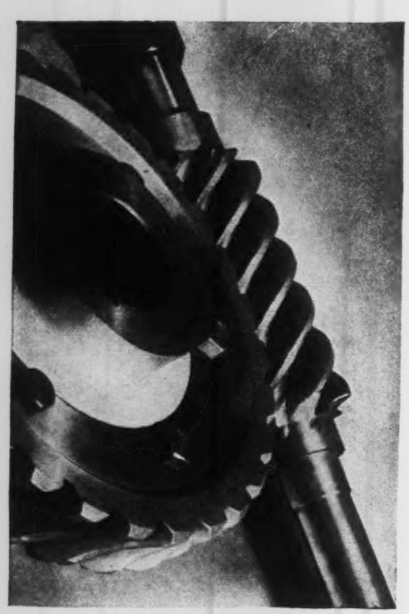
Modern machines deserve modern, time-tested speed control—to release their full capacities and to maintain uniform quality at a faster rate. Why not talk with a REEVES engineer? Let him explain how simply and efficiently REEVES Speed Control works; how it provides an infinite number of operating speeds on the machines it regulates to compensate for costly variable factors that affect the quality and quantity of production. Let him give you a quick picture of the complete REEVES line built around three basic units—the REEVES Transmission for accurate speed variation over wide range and heavy duty service; the Vari-Speed Motor Pulley, a simple direct drive for light h. p. machines; and the Motodrive, which combines in one compact unit, a motor, speed varying mechanism and reduction gears. Write us. No obligation.

REEVES SPEED CONTROL

UNEQUALLED EXPERIENCE . . . COMPLETE LINE OF EQUIPMENT . . . NATION-WIDE ENGINEERING SERVICE

REEVES PULLEY CO., Dept. G-97, Columbus, Ind.
Send FREE copy of latest edition of your Speed Control Handbook, which describes and illustrates the complete REEVES line and its use as standard equipment by builders of 1150 different machines.

NAME______________________________
COMPANY___________________________
ADDRESS___________________________



THEY SERVE FOR *Years*

Each succeeding year lengthens the performance records of some of the earliest Cleveland Worm Gear Speed Reduction Units.

Many of these "old-timers," installed soon after this Company's establishment in 1912, are still located where first installed and are operating continually without letdown, appreciable wear, or need of parts replacement.

This remarkably long life is due to the perpetually smooth action of worm and gear in Cleveland Units. They not only operate in the closest contact when new, but maintain perfect conformity throughout years of steady service.

While your primary interest in "Clevelands" is knowing what they will *do* in the Machine Equipment you design and build, it is also worth your while to know some of the "whys." A District Engineer will gladly consult with you on worm gear drive applications to your present or redesigned equipment. The Cleveland Worm & Gear Company, 3264 E. 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication.

CLEVELAND *Worm Gear Drives*

The Standards COLUMN

News of Interest to Manufacturers

Twist Drills

The users of twist drills have for a number of years urged the simplification of the list of sizes. In the opinion of many of them there is now an unnecessary overlapping and multiplicity of these sizes in the present combination of commercial standards including (a) fractional, (b) letter, (c) wire gage, and (d) millimeter series covering small diameter drills ranging from 0.0135 to 0.500 in.

This proposal fell within the scope of the Sectional Committee on the Standardization of Small Tools and Machine Tool Elements (B5) so it was assigned to that committee by the American Standards Association. In due time Technical Committee No. 7 was organized and W. C. Mueller was elected chairman and W. F. Wise, secretary. The first meeting of the committee was held in December, 1928, and in July of the next year the first tentative draft of the committee's report was distributed for criticism and comment.

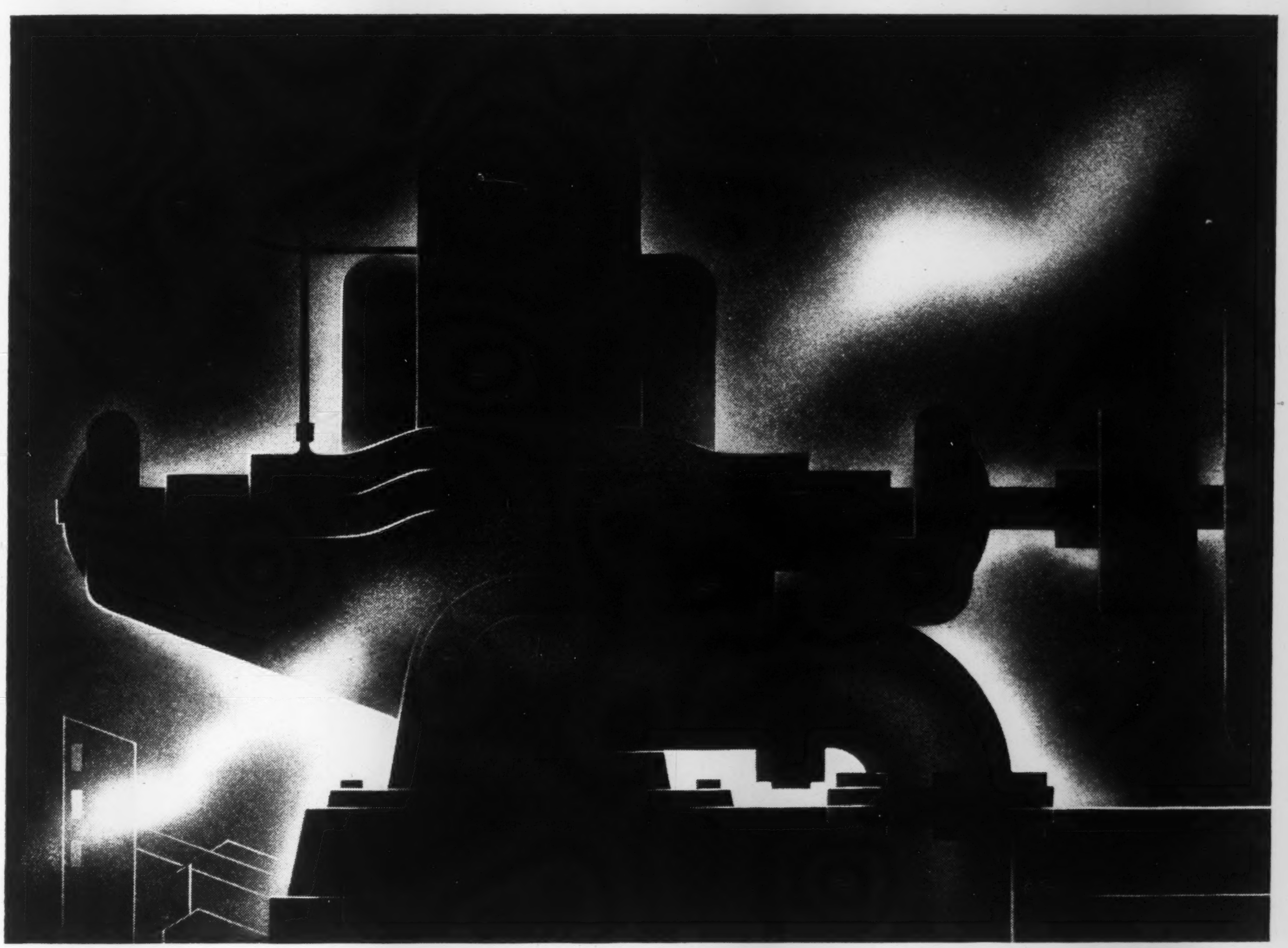
A subsequent revision of this draft based on the replies received was prepared in May, 1933, and the final draft was presented to the members of the sectional committee in August of the same year for vote on approval by letter ballot. Approval of the members of the sectional committee and the sponsor societies was secured by February, 1934, and in September the proposed standard was submitted to the A.S.A. for final approval.

In view, however, of certain objections raised by the drill manufacturers, chief among these being the inclusion of new sizes in the proposed standard series, the A.S.A. appointed a special investigating committee to determine whether this proposal should be adopted as an American Standard under the usual procedure. Upon the recommendation of this special committee, Technical Committee No. 7 agreed to revise its proposal with the cooperation of the drill manufacturers. Accordingly, a revised series comprising 116 sizes selected from the existing catalog sizes, together with certain slight changes in length, was decided upon. The proposal in this revised form was approved by the technical committee at its meeting in December, 1935, and with the date of January, 1936, it was presented to the members of the sectional committee for letter ballot vote the following February. This proposal was limited to straight shank drills in a "regular" and a "long" series and uniform increments within the different ranges of sizes covered were maintained as nearly as possible without the introduction of new diameters.

During the period of the February, 1936, letter ballot vote further negotiations with the drill manufacturers were carried on which resulted in modification of the January, 1936, proposal. In accordance with the agreement reached at this time, the technical committee accepted the existing manufacturers' lengths of drills for sizes smaller than $^1/_4$ in. in diameter, added the 0.0629 in. size to the list, and adopted a size range for the "long" series drills which was limited to the fractional sizes, in line with current practice. The proposal, revised again to include these changes, was approved by the sectional committee in October, 1936.

For further information—address

The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.



Obvious—or Effective

When machine parts failures become a problem, the obvious remedy is not always the most effective.

An important and alert manufacturer of centrifugal pumps, for instance, had impeller trouble. Steel impellers were the obvious answer, but cost was a factor to be considered.

A .75% Moly iron was used—and the trouble was eliminated. This hard, strong, fine-grained iron had the necessary resistance to the abrasive action of the material handled by the pump. And—it held down the manufacturing cost.

Moly toughens cast iron, assures uniform structure throughout varying sections, and reduces porosity. It produces irons with high wear resistance and greater strength. It cuts production cost by eliminating many of the causes of rejects.

Our technical book, "Molybdenum," contains practical data on Moly irons and steels. It will be sent on request—as will our monthly news-sheet, "The Moly Matrix." Be free to consult our laboratory on special ferrous problems. Climax Molybdenum Company, 500 Fifth Avenue, New York City.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

MOLY

Climax Mo-lyb-den-um Company

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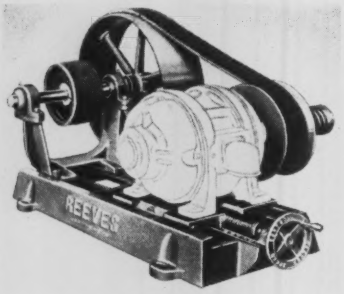
Available literature may be secured by addressing a request to the Advertising Department of MECHANICAL ENGINEERING or by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as the source.

Announcements from advertisers in MECHANICAL ENGINEERING and the MECHANICAL CATALOG

• *NEW EQUIPMENT*

Improved Vari-Speed Motor Pulley, Countershaft Type

Reeves Pulley Co., Columbus, Ind., manufacturer of REEVES variable speed control equipment, has developed a new and improved design of the Vari-Speed Motor Pulley, countershaft type. The Vari-Speed Motor Pulley is a simple, compact variable speed unit which is mounted on the standard shaft extension of any constant speed motor. It forms direct drive from motor to driven machine. Through handwheel control, a sliding base on which motor and unit are mounted is moved forward or back, varying the diameters of a set of adjustable discs from which a V-belt runs to the driven machine. Desired speed changes are made as the belt runs from maximum to minimum disc diameters.

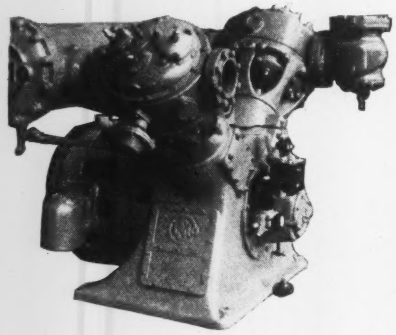


For requirements of either unusual speed reduction or speed increase, a countershaft is mounted on a common base with the rest of the unit. In the former design of this unit, the pulley, on the countershaft from which power take-off was made to the driven machine, was mounted on the end of the shaft. In the new design, illustrated, this pulley may be mounted in the center of the countershaft, between the two bearing housings, thus providing a much more compact, space-saving unit in installations where this factor is important.

While a straight-face pulley is illustrated, power take-off may also be from sprocket, pinion, multiple V-belt, sheave or any other accepted drive. The countershaft supports are extremely strong, rigid and heavily braced so there is no possible chance of vibration or twisting in the countershaft. The REEVES Vari-Speed Motor Pulley is built in seven sizes, transmitting from fractional to 7½ h.p., and covering speed ratios of 3:1.

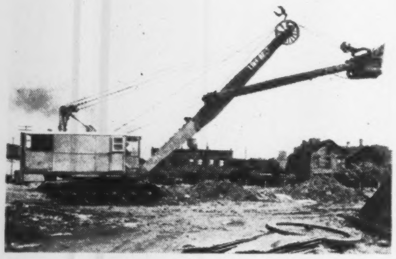
Industrial Compressor

Sullivan Machinery Co., 913 Woodland Ave., Michigan City, Indiana, announces the new Sullivan Class WN-112 Air or Gas compressor, in displacement sizes of 378, 480, 642 and 800 cubic feet per minute, is claimed to have great economy of power, maintenance, investment, installation and space. The most advanced design, with the use of modern alloys and precision manufacture, make the performance of this new industrial compressor outstanding. It is a continuous heavy duty machine which, while built for any type drive, reaches its greatest efficiency with the built-in motor. Thus equipped it requires only 6 feet by 8 feet floor space for any of the above capacities.



Vacuum pumps, boosters for steam or gas and low or high pressure machines are available in this new type of construction. Test units have been in actual factory service for over a year and remarkable performance is reported. This compressor is equipped with the new "Dual-Cushion" Valves, a feature just recently perfected by Sullivan engineers. The compactness and ease of installation of the Sullivan WN-112 compressor make it ideal for supplementing present equipment and it can be easily installed at any convenient point where electric power and running water are available.

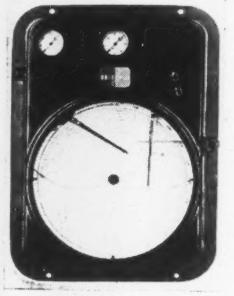
10% Less Weight Due to Welding



Crawler shovel equipped with new all welded boom and dipper stick, designed and built by Link Belt Company, Chicago, Illinois. The boom is 36 feet long, the stick 28 feet long. This shovel has a greater reach than the former designs with 35 foot boom and 21 foot stick. The bottom end of the boom is flared so as to eliminate "hog rods" and afford greater stability and strength. In spite of this greater strength and size at the bottom of the boom, the welded design weighs 10% less than the old riveted design. It is said to be twice as strong and costs approximately 20% less. The welded design has also permitted the use of a larger sheave (48 inches in diameter) because of the greater strength and rigidity at the sheave end of the boom. The welding was done with shielded arc equipment supplied by The Lincoln Electric Company, Cleveland, Ohio. This particular shovel was sold to an Ohio coal company for strip mining use.

New Round-Chart Potentiometer Pyrometer Controller

A new round-chart pyrometer controller has been developed by The Bristol Company, 21 Bridge Street, Waterbury, Conn., known as Bristol's Pyromaster Controller. This instrument is a potentiometer pyrometer, operating on a greatly simplified principle and is available in both pneumatic and electric types. It uses standard thermocouples and extension leads, and is for direct ink-marking on a round 12-inch chart, or for indicating on a large scale. Bristol's Pyromaster Controllers require no lubrication; they are not affected by plant vibration; there is no mechanical motion of any kind, except when a change in the measured temperature takes place. The extreme simplicity of the operating principle used, makes it possible to place the entire mechanism in a standard Bristol's instrument case.



These potentiometer pyrometer controllers are automatically self-balancing and self-compensating for cold-end temperature changes. The penarm or indicator is actuated in small steps that follow each other at a rate depending upon the rate of change in the temperature at the thermocouple. All lag is thus eliminated, permitting immediate response to changes exactly as they occur. Bristol's Pyromaster is available as: (1) A Recorder, (2) A Recorder with Indicating Scale, (3) A Recorder Controller, (4) A Recorder Controller with Indicating Scale. A copy of Bulletin No. 489 on Bristol's Pyromaster Controllers may be obtained upon request.

J & L Automatic Thread Grinding Machine

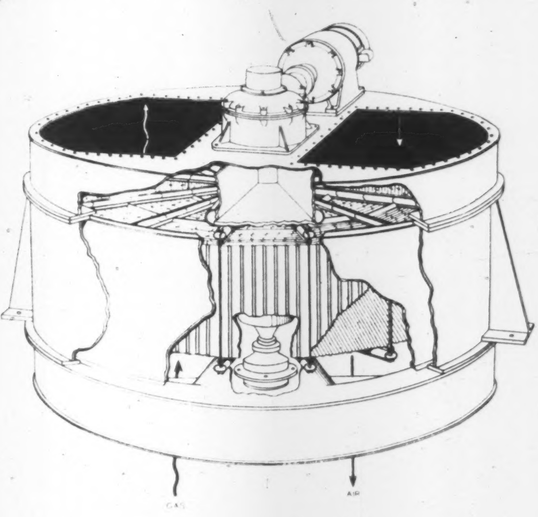
The Jones & Lamson Machine Co., Springfield, Vermont, announces a new J&L Automatic Thread Grinding Machine. This new machine is designed to grind threads in hard or soft materials on work up to 8 inches in diameter when using a 20-inch grinding wheel. Work 48 inches long may be held between centers, and 18 inches of thread may be ground anywhere on 36 inches of work length. Work 11½ inches in diameter may be swung over the work slide and 11½ inch diameter threads may be ground when the wheel is 16½ inches in diameter, or smaller. A 20-inch diameter grinding wheel is furnished as standard, and, as the wheel decreases in size, the proper peripheral speed may be retained through rheostat control of the wheel motor. The helix angle capacity of the new machine has been increased to include 25 degrees right hand and 30 degrees left hand. Standard equipment includes change gears for pitches from 2 to 48 inclusive. The machine will grind single, double, triple, quadruple and

Continued on Page 24

AIR PREHEATERS

A Turbulent Flow of Gas and Air Combats Stratification

. . . and Insures the Highest Heat Recovery



Ljungstrom

one inch of Ljungstrom heating surface is approximately equivalent to one foot of plate or tubular heating surface

The Ljungstrom heating surface prevents stratification of gas and air flow.

This is one of the many factors that are responsible for one inch height of Ljungstrom heating surface being equivalent to approximately one foot of any other type of heating surface.

The Ljungstrom air preheater is generally accepted as the standard air preheater for high heat recoveries.

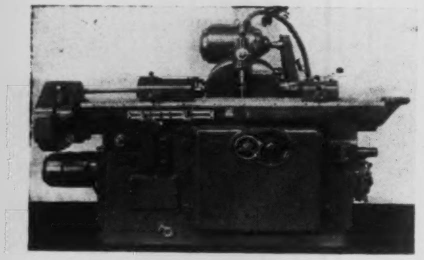
THE AIR PREHEATER CORPORATION

Under the Management of THE SUPERHEATER CO.
60 East 42nd Street New York, N. Y.

A-1162

Continued from page 22

sextuple threads, either right or left hand. Using a simple hardened and ground former, it will grind taper, combination of straight and taper, or double taper threads. Accurate reproduction of taper is assured.

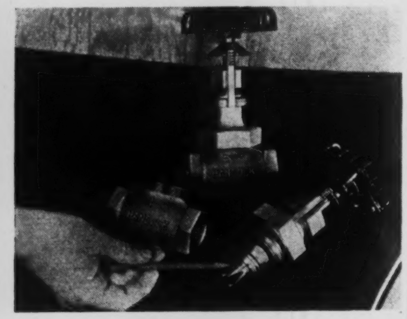


The new machine, with the necessary attachments, will grind button type hobs and circular chasers without lead; it will back off, or relieve, straight or taper hobs or taps with either straight or spiral flutes. A standard attachment may also be furnished for grinding interrupted threads on straight- or spiral-fluted taps.

A direct current motor is recommended for driving the grinding wheel. One of the most important features is the provision made for running all types of grinding wheels at efficient work speeds. While it is possible to furnish an alternating current motor for driving the wheel, the company discourages the practise. Either alternating current or direct current motors can be furnished for the wheel trueing device, coolant pump and for operating the machine. The self-trueing, self-sizing mechanism of this machine brings thread grinding into the range of practical shop operations. It is suited equally well to tool room and production work.

New Hancock Flocontrol Valve

The Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Connecticut announce a completely redesigned line of Hancock Bronze Flocontrol Valves. These novel valves are in reality a combination flow instrument and shutoff valve. And the makers claim the rapidly increasing sales have made possible improving the design and materials and lowering prices.



This new line of Flocontrol Valves retains the basic proportional flow or straight-line flow characteristic of the original valve. The makers state that their pioneering with superhard stainless steel valve seats and discs of 500 Brinell hardness has been so successful that the Flocontrol line now also possesses this added wear-resisting feature. Like other Hancock valve seats and discs, those for the new Flocontrol are so hard that they are made on *Diamond Boring Machines*. It is also claimed that these new hard valve seats and discs will smash nails, pipe turnings, welding chips and boiler scale without leaving a trace on either the seat or disc.

The new Hancock Flocontrol Valves have an entirely new body of the Union Bonnet type instead of the inside screw bonnet originally used. Increased production and the latest manufacturing equipment permit these improved and better Flocontrol Valves to be sold for considerably lower prices than heretofore the makers say.

Flocontrol Valves are widely used for all sorts of temperature control for gas-fired, oil-fired or steam-heated processes; for proportional blending of liquids, water softening systems, oil burner lines, continuous boiler blow-down and hundreds of others, the makers state.

An illustrated eight page bulletin is just off the press giving full particulars of design, materials and applications and will be sent on request.

• BUSINESS CHANGES

E. S. Crosby New President of Johns-Manville International Corp.

Lewis H. Brown, president of the Johns-Manville Corporation, has announced that E. S. Crosby has been named president of the Johns-Manville International Corporation, a subsidiary.

Mr. Crosby joined Johns-Manville in 1928 when it absorbed the Celite Company, of which he was vice president and a director. His first position with J-M was as general manager of the Engineering Department. In 1929, when the Johns-Manville International Corporation was formed, he became vice president and general manager. The presidency of the International Corporation has been held by Mr. Brown.

In addition to his new post, Mr. Crosby is also general manager of both Asbestos Fibres Distributors and the Replacement Automotive Products Department, both divisions of the J-M Sales Corporation.

New Linde Sales Office

The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, has opened a new sales office in Oakland, Calif., at 3710 San Pablo Avenue. The opening of this new office on September 1, 1937, brought the number of Linde offices throughout the country to a total of thirty-three. This office will serve the Oakland area, supplementing the San Francisco office.

International Nickel Expands Technical Service Staff

A. J. Wadhams, Vice-President in charge of Development and Research, The International Nickel Company, Inc., 67 Wall Street, New York, N. Y., has announced the addition of Wayne Z. Friend to the Development and Research Staff.

Mr. Friend will devote most of his time to technical service on corrosion resisting materials, particularly Monel, Nickel and Inconel. His experience has been principally in the petroleum and natural gas industries and covers the production, refining and marketing of petroleum products, natural gas and liquefied petroleum gases.

After graduation from West Virginia University in 1926 with a Master's degree in Chemical Engineering, Mr. Friend engaged in the production and marketing of natural gasoline with Gasoline Recovery Corporation, Charleston, W. Va. During the past seven years he has been associated with Phillips Petroleum Company and, as Chief Technologist of Philgas Department of that company at Detroit, Mich., has been recently engaged in the industrial application of liquefied petroleum gases to heat treating requirements of the automotive and other metal industries. He has been active on Committees of the American Gas Association, National Bottled Gas Association and American Society for Testing Materials.

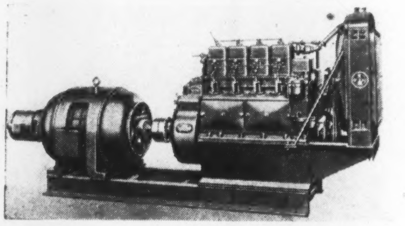
• LATEST CATALOGS

Perforated Metals

Allis-Chalmers Mfg. Company, Milwaukee, Wisconsin, has released a new 24 page Bulletin 1832 on PERFORATED METALS for all manner of applications whether requiring rolled or flat plates, in all common commercial grades of steel plates or sheets, or in any other metal material used in screens, in thicknesses up to $^{3}/_{4}''$ and sizes of perforation proportioned to the thickness of the metal used. The Bulletin includes a larger number of cuts illustrating some of the many kinds of perforated plates the Company is in a position to furnish and includes many tables of interest to those who have any use for perforated metal.

F-M Diesel Generating Sets

A new Bulletin, No. 3600-A2, just issued by Fairbanks Morse & Co., 900 South Wabash Ave., Chicago, Ill., describes and illustrates the construction and application of Fairbanks-Morse Model 36-A Diesel generating sets. These sets are widely used in industrial plants, either as independent units carrying the entire load or for parallel or auxiliary operation in conjunction with other electrical service. Their compact design fits them for service on machines requiring individual power plants, such as electrically operated shovels and dredges and they are readily adaptable as portable and semiportable electric power plants on construction work, in lumber camps, etc. Because of their construction with a substantial common sub-base, they may be installed on simple foundations, making them especially suitable as marine auxiliaries.



True Diesel economy and dependability are available in the F-M Model 36-A sets. They represent an outstanding development in the design and construction of unit-built generating plants in comparatively small capacities. They are compact, are easily installed, and can be operated with little attention. Alternating current sets are offered in ratings from 5.3 to 100 kva. and direct current sets fom 5 to 80 kw.

Welded Piping Systems

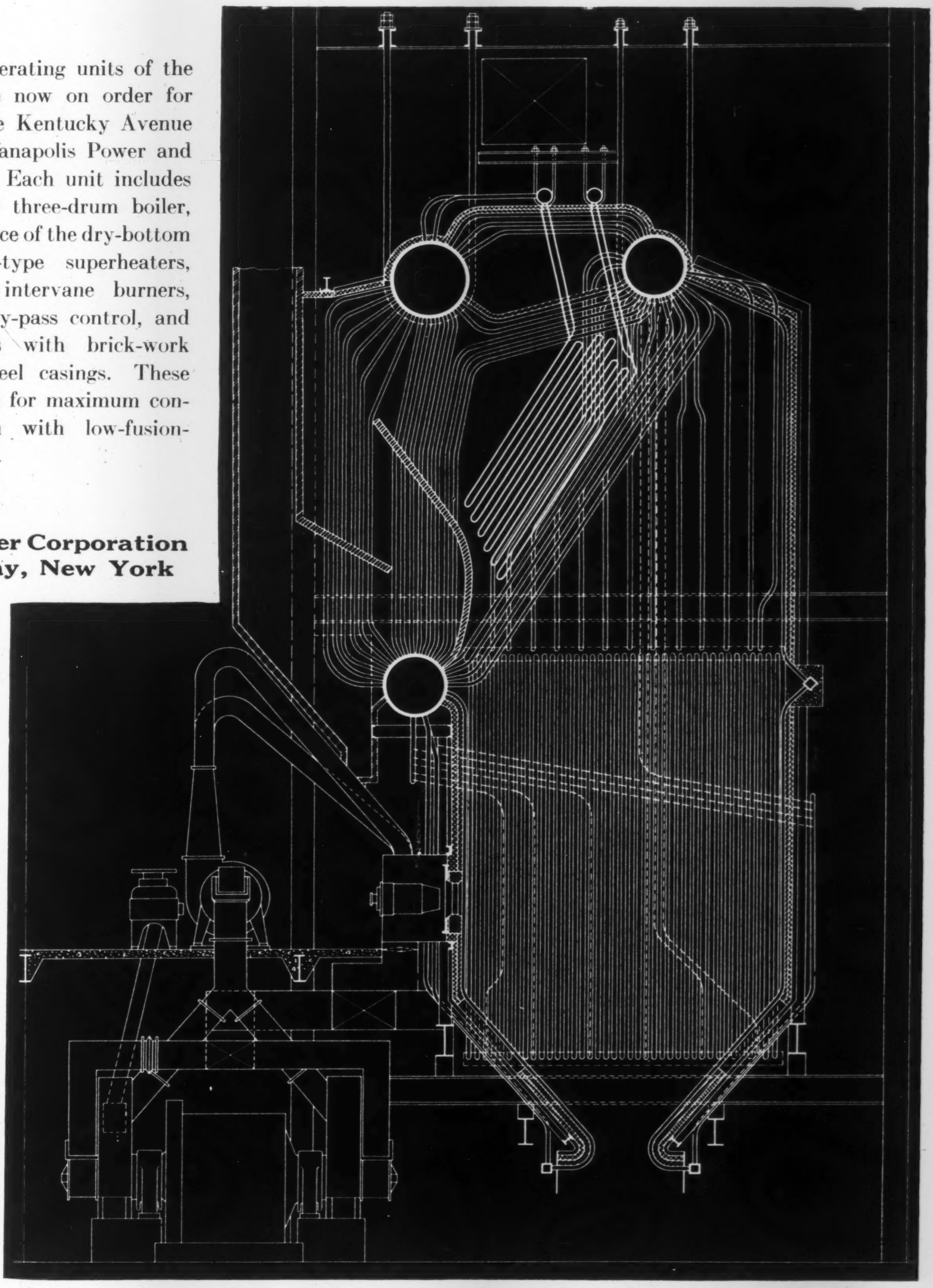
The advantages of welded joints in installing piping systems are discussed in "welded Piping," a 12-page, illustrated booklet, pub-

Continued on Page 26

Indianapolis Power and Light Company

Two steam generating units of the design shown are now on order for installation at the Kentucky Avenue Plant of the Indianapolis Power and Light Company. Each unit includes a Foster Wheeler three-drum boiler, water-cooled furnace of the dry-bottom type, convection-type superheaters, fuel pulverizers, intervane burners, superheater gas by-pass control, and complete settings with brick-work insulation and steel casings. These units are designed for maximum continuous operation with low-fusion-point Indiana coal.

Foster Wheeler Corporation
165 Broadway, New York



The design conditions are:

Capacity—
350,000 lb. per hour

Pressure—
675 lb. per sq. in.

Steam temperature—
786 deg. F.

Preheated air—
525 deg. F.

Fuel—Low-fusion-point Indiana coal

Maximum moisture in coal—16 per cent.

FOSTER WHEELER

• Keep Informed . . .

Continued from page 24

lished by The Linde Air Products Company, 205 East 42nd Street, New York, N. Y. Subjects of particular interest to builders, architects and engineers are treated in sections on: pipe and services to be welded; lighter than standard weight pipe; fast, economical welding methods; layout, drawings and specifications; welded joints and fittings; plan of construction; shop and field fabrication, and piping erection.

Mechanical Topics

The International Nickel Co., 67 Wall Street, New York, N. Y., is now issuing "Mechanical Topics," a quarterly publication which will be sent free on request. A bulletin for metal users, fabricators and designers.

Link-Belt Book on Friction Clutches

A 16-page illustrated list-price catalog No. 1532 on friction clutches, has been completed by Link-Belt Company, Chicago, Philadelphia, San Francisco, and is now available for distribution. Besides giving sizes, dimensions, weights, horse power ratings, and other pertinent tabular data on both Meeseco and Twyncone types of clutches, the book devotes two pages to the subject of how to select and order the right clutch for the service.

Sub-station Service Transformers

Allis-Chalmers Mfg. Company, Milwaukee, Wisconsin, has issued an attractive new leaflet 2259 describing and illustrating industrial sub-station service transformers.

Nickel Cast Iron Data

Harassed by the necessity for frequent replacement of equipment, much of which is subjected to unusually severe conditions of corrosion and wear, and to extremes of temperature, the refinery industry has been continually alert to investigate and adopt promising developments in metallurgical practice.

A most important trend in the development of modern engineering materials is the steadily widening field of application for the cast metals, especially the cast irons. This results from the marked improvement in mechanical property values now attainable, and the advance in foundry technique which permits successful production of castings formerly considered troublesome.

Comparative service data and useful information on properties of numerous cast irons now readily available are contained in the publication just issued by The International Nickel Co., 67 Wall Street, New York, N. Y. Recommendations of suitable cast iron compositions are made for typical refinery installations.

New Whiting Bulletins

Whiting Corporation, Harvey, Ill., has just been issued two new bulletins which are now available for distribution. Bulletin No. 222 describes the benefits from use of Whiting H. C. Stokers, and No. 224 presents a variety of designs of Jib and Pillar Cranes.

"Barriers to Industrial Waste"

A new edition of the 68-page insulation booklet, "Barriers to Industrial Waste," has been published by Johns-Manville, 22 East 40th Street, New York, N. Y. This booklet contains a complete and improved table of recommendations to serve as a guide to the proper selection of J-M Insulations for a wide variety of uses in practically all industries. Amply illustrated, it describes in detail more than 50 different insulations for all types of heated or refrigerated equipment. Added features of this new edition are: a section dealing with JM-20 Brick, a new type of 2000° F. insulating brick; a page describing Stonefelt, a new insulation composed of mineral fibers for use on railroad passenger cars, refrigerator cars and buses; and information on other products recently developed by Johns-Manville.

Rotary Displacement Pumps

A rotary displacement pump intended primarily for fuel, lubricating and heavy crude oils, and called the De Laval-IMO pump, is described in Catalog L-32 issued by the De Laval Steam Turbine Co., Trenton, N. J. This pump, which is designed to run at conventional motor and turbine speeds, has only three moving parts, a central or power rotor and two idler or sealing rotors. The spindle of the power rotor is extended through a stuffing box for connection to the driving motor, but there is no other stuffing box, also no pilot gears, no bearings and no valve. All moving parts are in hydraulic balance axially and in rotational balance. Pumps of this type are built in all capacities and for pressures up to 500 lb. Pumps for higher pressures can also be supplied.

Steam Condensers

Bulletin 1541 on Steel Shell Surface Type Steam Condensers has been released by Allis-Chalmers Mfg. Company of Milwaukee, Wisconsin. In addition to a well illustrated section on condensers it includes related auxiliary equipment such as motor and turbine driven condensate pumps.

Bent-Tube Boilers

Combustion Engineering Company, Inc., 200 Madison Ave., New York, has just issued another of its series of equipment catalogs. This covers its extensive line of CE bent-tube boilers, many pages being devoted to cross-sections of typical installations of various types, in addition to descriptive matter, photographs of furnace and boiler details, and shop views showing the fabrication of high-pressure, fusion-welded drums from the bending of the plate to the finished product, including X-ray examinations. The catalog is printed in two colors and is attractively illustrated.

Barnes Piston Feed Pump

A new bulletin which has just been issued by W. F. & John Barnes Co., Rockford, Ill., illustrates and describes their Piston Feed Pump.

F-M Steam Pumps

Fairbanks-Morse Steam Pumps, described in Bulletin 6205, just issued by Fairbanks, Morse & Co., 900 South Wabash Ave., Chicago, Ill., are suitable for a wide range of pumping applications. They have been designed to pump water, oil and similar liquids at pressures up to 420 lb. per sq. in. in quantities up to 464 gal. per min.

Both the F-M General Service and Low Service steam pumps are of the duplex piston pattern type. General Service units are offered in one-piece and two-piece patterns. In most sizes of Low Service pumps, the steam and fluid ends are cast separately, then assembled, forming the two-piece pattern.

Numerous refinements in design and construction contribute to the extra dependability and efficiency of Fairbanks-Morse pumps. Accurately made parts are carefully assembled by experienced workmen, and completed pumps must satisfy rigorous tests before leaving the factory.

COMING MEETINGS AND EXPOSITIONS

For the next two months

OCTOBER

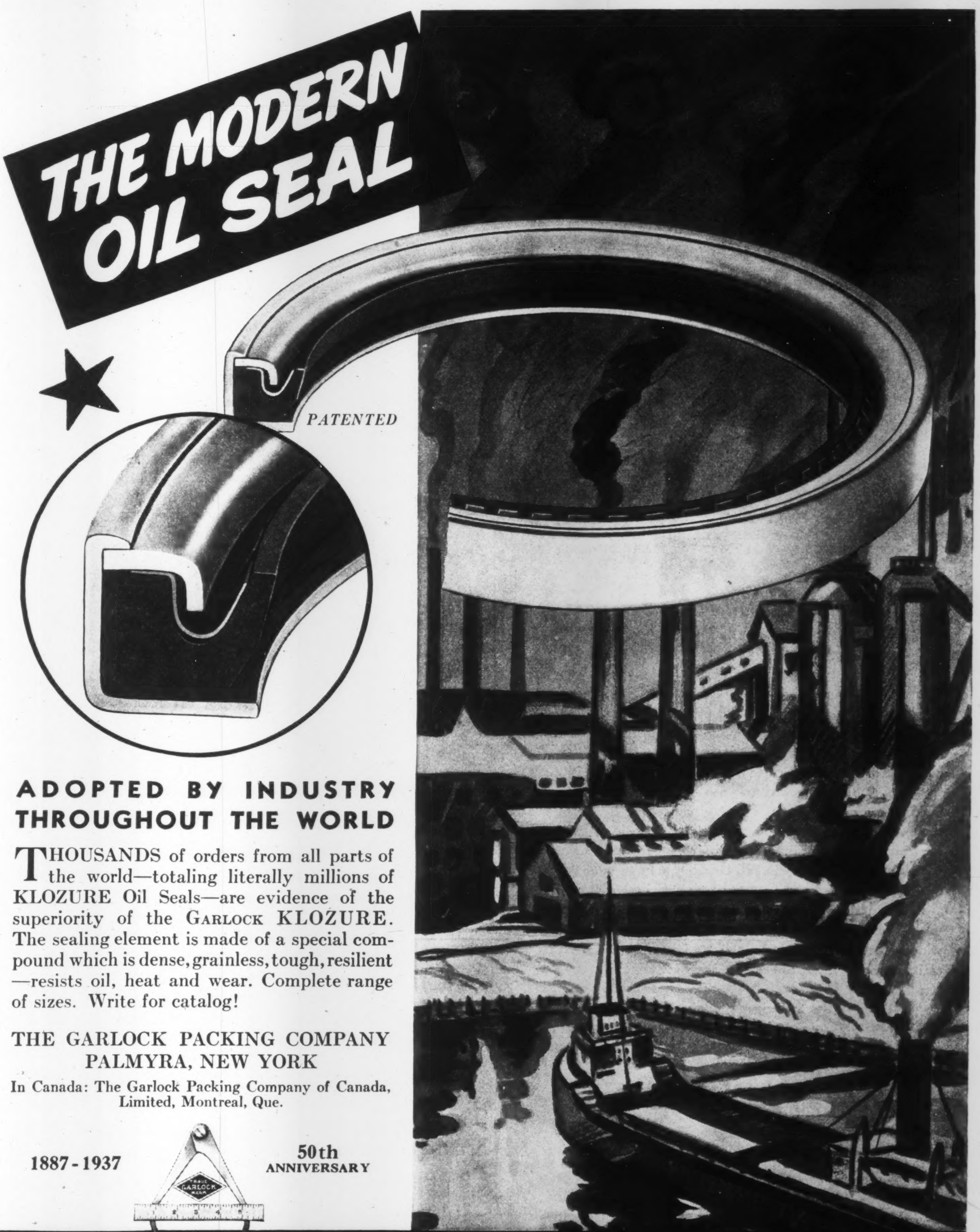
4–6	**American Society of Mechanical Engineers,** Fall Meeting, Lawrence Hotel, Erie, Pa.
6–8	**American Society of Civil Engineers,** Fall Meeting, Boston, Mass.
7–8	**American Institute of Mining & Metallurgical Engineers,** Petroleum Division, Oklahoma City, Okla.
9	**Joint Engineers Meeting** to be held during Anthracite Week in Scranton, Pa. It will be sponsored by the local sections of **The American Institute of Mining and Metallurgical Engineers,** the **American Institute of Electrical Engineers,** the **American Society of Mechanical Engineers,** and the **Chambers of Commerce in the Anthracite Field.**
11–15	**National Safety Council,** 26th National Safety Congress & Exposition, Kansas City, Mo.
14–16	**Society of Automotive Engineers, Inc.,** National Aircraft Production Meeting, Los Angeles, Calif.
14–16	**American Institute of Mining & Metallurgical Engineers,** Industrial Minerals Division, Fall Meeting, to be held jointly with Washington, D. C., Section, Washington, D. C., and College Park, Md., where the Eastern Experiment Station of the U. S. Bureau of Mines will be dedicated on the 15th.
18–22	**American Society for Metals,** National Metal Congress & National Metal Exposition, Auditorium, Atlantic City, N. J.
18–22	**American Welding Society,** Annual Meeting & Exposition, Traymore Hotel, Atlantic City, N. J.
18–22	**Joint Meeting of the A.S.M.E. Machine Shop Practice Division** with **American Welding Society** and **American Society for Metals,** Traymore Hotel, Atlantic City, N. J.
25–27	**National Machine Tool Builders Association,** Annual Convention, Hot Springs, Va.
27–29	**A.S.M.E Fuels Division** and **American Institute of Mining & Metallurgical Engineers Coal Division,** William Penn Hotel, Pittsburgh, Pa.

NOVEMBER

9–12	**American Petroleum Institute,** 18th Annual Meeting, Stevens Hotel, Chicago, Ill
17–19	**American Institute of Chemical Engineers,** 30th Annual Meeting
18–19	**Society of Naval Architects and Marine Engineers,** Annual Meeting, Waldorf-Astoria, New York, N. Y.

DECEMBER

6–10	**American Society of Mechanical Engineers,** Annual Meeting, New York, N. Y.
27–Jan. 1, 1938	**American Association for the Advancement of Science,** Winter Meeting, Indianapolis, Ind.



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THOUSANDS of orders from all parts of the world—totaling literally millions of KLOZURE Oil Seals—are evidence of the superiority of the GARLOCK KLOZURE. The sealing element is made of a special compound which is dense, grainless, tough, resilient—resists oil, heat and wear. Complete range of sizes. Write for catalog!

THE GARLOCK PACKING COMPANY
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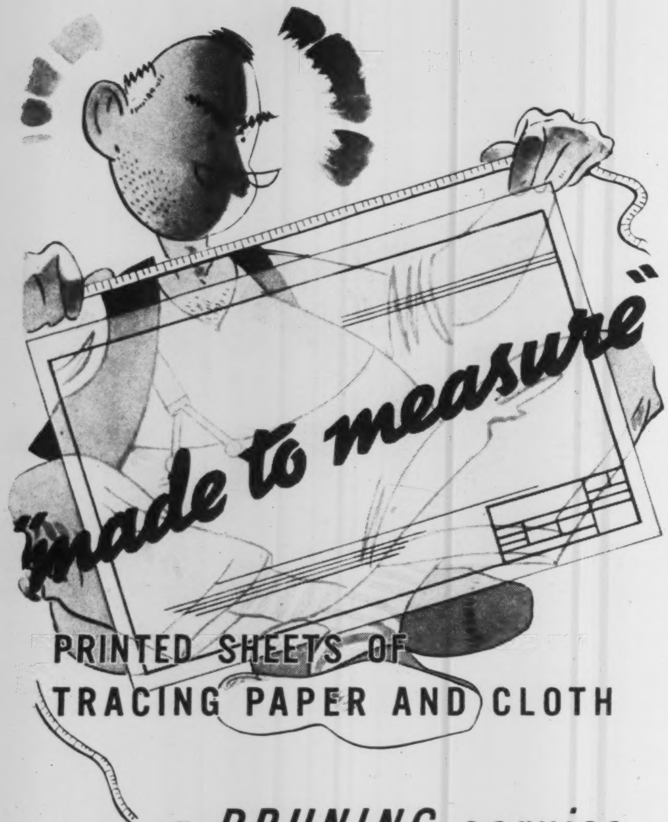
In Canada: The Garlock Packing Company of Canada, Limited, Montreal, Que.

1887 - 1937 50th ANNIVERSARY

Garlock KLOZURE



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Kansas City, Mo........................1320 Walnut St.
Houston, Texas.........................1 Main St.
Los Angeles, Cal.......................818 Santee St.
San Francisco, Cal.....................638 Mission St.

(838)

The Standards COLUMN

News of Interest to Manufacturers

Cast-Iron Soil Pipe and Fittings

The new American Standard for Cast-Iron Soil Pipe and Fittings, developed through the cooperation of some twenty-two (22) organizations under the auspices of the American Standards Association, is achieving wide recognition on the part of municipal, state and federal agencies in the building field.

The City of New York through action of its Board of Buildings has this year approved the use of extra-heavy cast-iron soil pipe made in accordance with the new American Standard specifications. This means that installation of the new pipe and fittings will now be permitted in building construction throughout the city, making available important advances in this type of pipe and fittings. It is reported that similar actions are contemplated by Boston and Philadelphia.

Material made in accordance with this standard complies with Federal Specification WW-P-401, issued by the U.S. Director of Procurement to cover all purchases of such material by federal agencies.

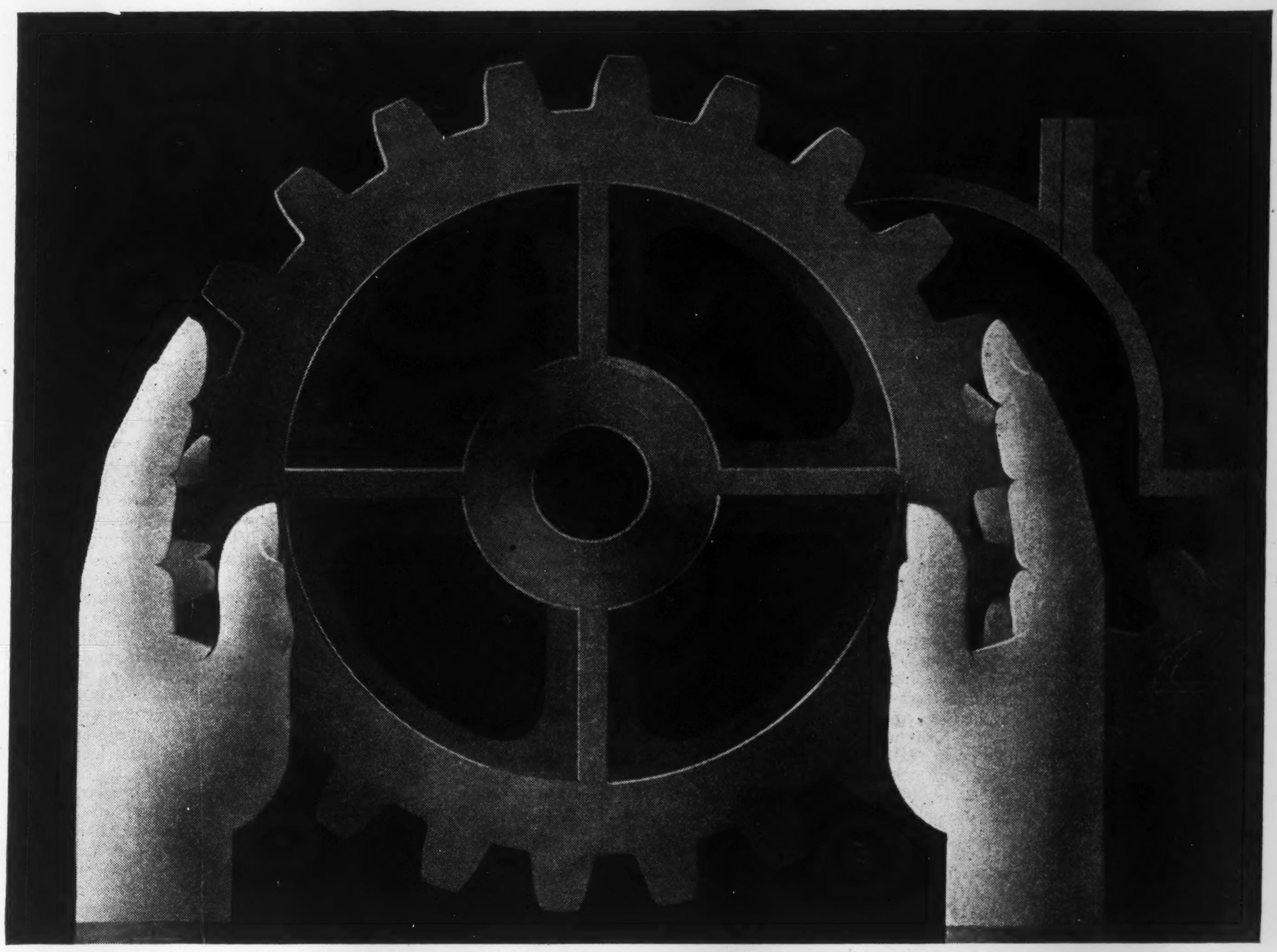
The manufacturers of soil pipe, who have been keenly interested in the development of standards in this field, officially adopted the American Standard in December, 1936 and are now in a position to furnish pipe and fittings in accordance with the standard for installation in both public and private construction. At first they believed that a two-year period would be necessary for pattern and plant development to care for changes in practices called for by the new standard. However, on January 1, 1937, the manufacturers announced that all sizes of pipe and fittings conforming to the new standard would be available from that date on.

The need for an American standard for cast-iron soil pipe and fittings has been apparent for some years. This project was undertaken in January, 1931 by a subcommittee, J. J. Crotty, chairman, and the work was completed and the standard approved by the American Standards Association in October, 1935. The development of this standard is part of a comprehensive program in the plumbing field being developed by a representative committee, W. C. Groeniger, chairman, organized under the procedure of the American Standards Association and sponsored jointly by the American Society of Sanitary Engineering and The American Society of Mechanical Engineers.

In August, 1936 the American Municipal Association circulated an announcement advising municipal officials that the new standard was ready for use. This announcement indicated the care which has been exercised in the development of the standard to harmonize the weights and lengths of soil pipe and fittings with trade requirements and the best sanitary practice. Therefore, municipal officials and others interested in the enforcement of plumbing codes and ordinances may now feel free to specify the new standard.

For further information—address

The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.



It "couldn't be done"—so MOLY did it

Parallel to the difficulty of putting square peg into round hole was the problem of a machinery manufacturer who needed a stronger gear, when space limitations prohibited making it larger.

A Manganese-Moly steel was used—and the problem was solved! . . . Without increase of size or weight, the needed strength was obtained.

Doing the unusual—saving material; increasing weight, strength ratio; simplifying fabricating processes; speeding production and reducing its costs—all have become a regular thing in the fast-moving history of industry's most versatile alloying element. Steels and irons containing Moly are demonstrating their many advantages both in the making and in the performance of many important products and equipment parts.

Our free technical book, "Molybdenum," will prove useful to engineers and production heads interested in cost cutting and product improvement. Our monthly news-sheet, "The Moly Matrix," keeps readers informed on Moly developments. Consult our laboratory when ferrous problems get tough. Climax Molybdenum Company, 500 Fifth Avenue, New York City.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

MOLY

Climax Mo-lyb-den-um Company

•Keep Informed . . .

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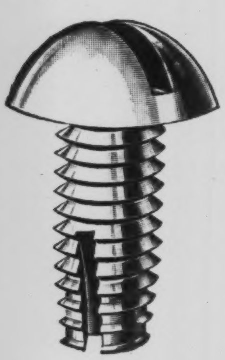
Announcements from advertisers in MECHANICAL ENGINEERING and the MECHANICAL CATALOG

• *NEW EQUIPMENT*

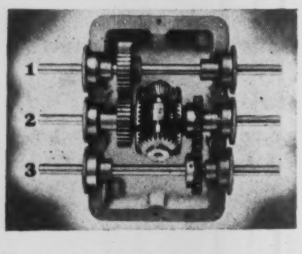
Thread-Cutting Screws with Standard Machine Screw Thread



The Shakeproof Lock Washer Company has recently announced the development of a screw that actually cuts its own thread in metals and plastics of practically any thickness. Its patented, thread-cutting slot, plus a special hardening process, eliminates the separate tapping operation normally required in the use of standard machine screws. Important production savings in both labor costs and time are assured by the use of this new fastening method and, because the screw remains in the threads it has cut, a better fastening is certain. Another advantage is the fact that, should it ever be necessary to replace the screw, an ordinary machine screw of the same size will fit its threads. A free demonstration kit of Shakeproof Thread-Cutting Screws, including an assortment of different sizes and complete instructions for testing, can be had by writing the Shakeproof Lock Washer Company, 2511 North Keeler Avenue, Chicago, Illinois.

New Reeves Differential Control

Supplementing its line of accessory equipment for use with the Reeves Variable Speed Transmission, Reeves Pulley Co., Columbus, Ind., has developed a new differential. This unit, known as model MDB-3, is similar in principle to the differential in a motor car. It is used for a variety of requirements in automatic speed control, such as synchronization of two or more machines or parts of a single machine, and maintenance of uniform peripheral winding or unwinding speeds.



Within a unit housing are mounted three parallel shafts operating in a bath of oil. Gears of 1:1 (stock) ratio drive between shaft 1 and the differential gearing. Between shaft 3 and the differential gearing is 1:1 chain drive. (Special ratios are also available.) For automatic control service, shafts 1 and 3 are connected to the driven machine or machines. Shaft 2 is connected to the speed changing screw of the Reeves Transmission. When shafts 1 and 3 are driven in the same direction at the same speed, shaft 2 stands still. When the speed of the driven machine varies above or below desired speed, this variation is transmitted to shaft 2 which speeds up or slows down the Transmission until synchronous speed is restored.

The differential may also be used as primary driving equipment for loads not exceeding its rated torque and speed capacity. For example, it may be used with other equipment to control index or register, either manually or with photo-electric equipment. Infinite range of speed variation is possible by connecting shafts 1 and 3 to the constant and variable speed shafts, respectively, of the Transmission. By turning the speed control handwheel on the Transmission, shaft 2 may be adjusted to any speed in either direction, including zero r. p. m. Overall dimensions of the unit are 8 inches wide, 11 inches long and $6^5/_8$ inches high. Shafts are extended on both sides so installation may be made as desired.

Revolutionary New Hancock Valve

The Hancock Valve Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn., announces a revolutionary new type of steel valve called the "Hancock Duravalve." This new valve has been developed expressly for high pressure and high temperature service (1500 pounds at 950°F.). The makers claim that Duravalves with internal Stellite seats put an end to valve maintenance due to steam leaking between the valve seat ring and the valve body. The accompanying illustration shows how the radically new design permits the Stellite seat facing to be easily welded in and serviced even on small size valves.

Hancock Duravalves are made in one basic size and then tapped, or bored for welding for $^1/_2''$, $^3/_4''$ or 1" pipe. The builders state that this simplification will take care of 90% of the small valve requirements on any high pressure power plant job, and that it cuts repair part stocks and maintenance parts by two-thirds. New illustrated bulletin sent on request.

New Model Polaroid Photoelastic Polariscope

Since the development of large aperture Polaroid, the field of photoelastic investigation has taken on considerable impetus. Previously, through the Nicol prism apparatus, one had to contend with the limitations of such prisms and the high cost of the apparatus. About six months ago, the Polarizing Instrument Co. brought out their first model large aperture photoelastic polariscope. In this apparatus they used the conventional type optical bench with necessary riders and mounts set on posts.

This usual type of set up has its objectionable features, especially for photoelastic work, and so a new model is now being announced. This new model is mounted on a bench consisting of two rectangular rails, with a glider supporting the necessary mounts and locking them in a fixed position; it is simply impossible to push any of the parts out of optical alignment. The light housing, contains in a single unit, the reflector, the bulb, the condenser, the filter for 5461 A°, the condensing lens and the collimating lens. This complete unit rests directly on the rails. One rider carries the mount for the polarizer and its quarter wave plate, but the quarter wave plate is mounted so that it may be swung in or out of position by a "flip of the finger" thus providing simple and almost instantaneous action for changing from circular polarized light to plane in diagramming the isoclinics. The analyzer mount is similar in construction to that of the polarizer. The projection system is likewise locked into position by a glider.

Again this instrument features large aperture Polaroid and large aperture quarter wave plates and in that manner, there are no lenses necessary at any point in the optical path between the polarizer and the analyzer, thus correcting the deficiencies and the limitations of the Nicol prism set up. Descriptive literature is available on request to the Polarizing Instrument Co., 8 West 40th St., New York City.

Jenkins Adds New Wheel, Index Plate and Disc to Standard Bronze Valves

Users of Jenkins Standard Bronze Valves will have the advantages of three new developments which add convenience and better service. A new handwheel design affords unusually large gripping area without bulkiness and because of its deeply depressed center will prevent the hand from touching a hot wheel nut. A new valve index plate, held in the depressed center of the wheel by the wheel nut, gives the figure numbers of the valve and the disc number and service to aid in ordering replacements.

JENKINS 106A
119A STEAM DISC

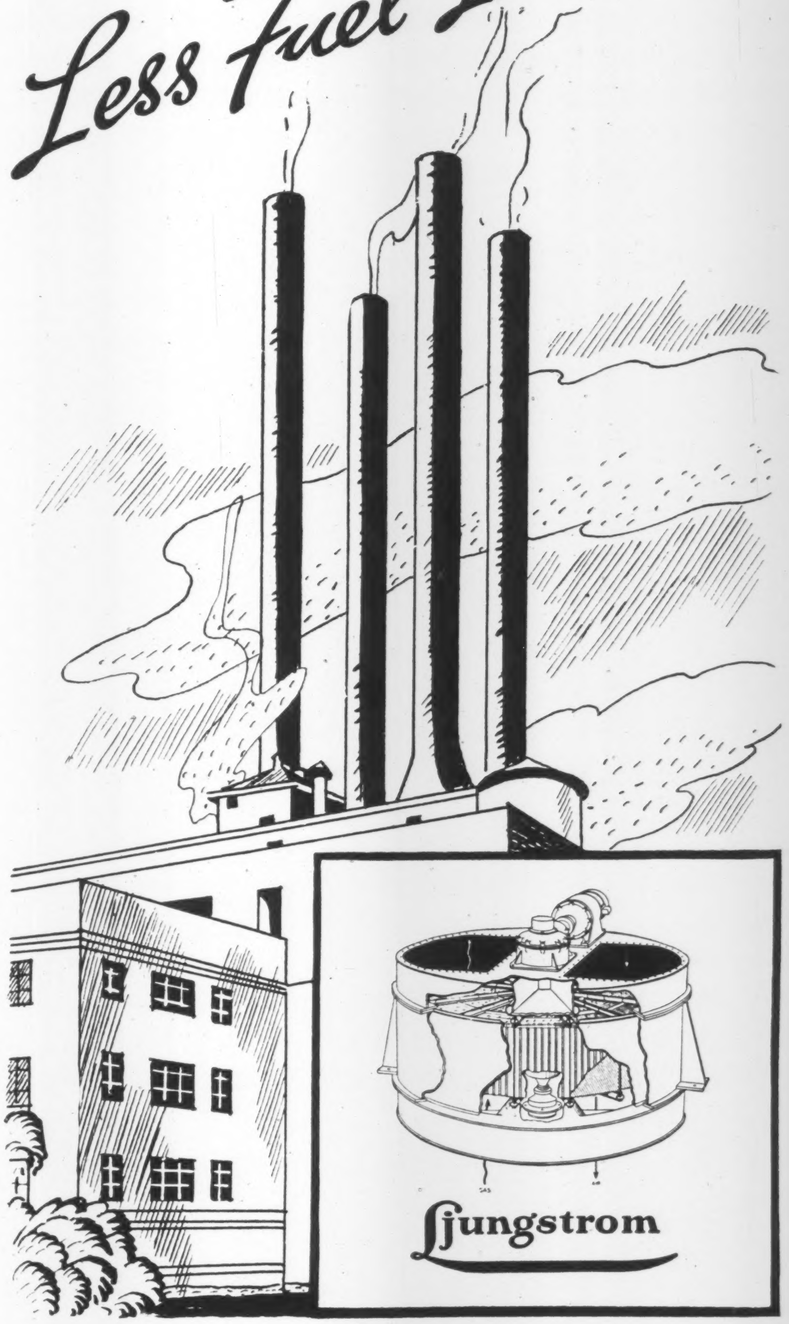
A new renewable composition disc is also offered with the statement that it has unheard-of life in steam service, being superior to other composition discs, including hard rubber and Bakelite. Also that Jenkins believes it to be the nearest thing to a "universal" disc that has ever been developed. Designated No. 119-A, this disc

Continued on Page 18

Less Fuel Lost in Ash and Smoke

. . . when using

PREHEATED COMBUSTION AIR



With preheated air, combustion starts quicker, and is more thoroughly completed within the furnace, resulting in less unburned fuel in the form of ash and smoke.

The accepted American standard for air preheater equipment with a high heat recovery . . . is the Ljungstrom regenerative counterflow type. Its exclusive design is responsible for one inch height of its heating surface accomplishing the same as twelve inches of any other design.

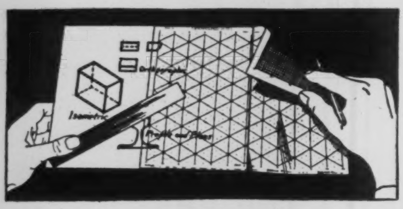
THE AIR PREHEATER CORPORATION

Under Management of THE SUPERHEATER CO.
60 East 42nd Street New York, N. Y.

A-1163

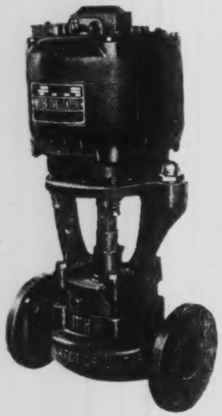
replaces disc No. 119. A folder of complete information about these and other features of Jenkins Standard Bronze Valves is available and may be obtained from Jenkins Bros., 80 White Street, New York, N. Y.

Sketch Pad Set



Intended to making any type of sketch to any scale, this set consists of a pad of tracing paper; a cellulose covered buff guide plate that slides under the top sheet of the pad, and is printed in blue ink showing ⅛" squares, every ½" line heavy and every 1" line numbered; and on the other side an isometric design with all three axes divided 1", ½" and ¼" so that drawings showing all six sides and interior may be made to any scale. Made in pads 200 sheets 5½" x 8½"; 100 sheets 8½" x 11"; 50 sheets 11" x 17", each with guide plate to match. Pads made with light or heavy tracing paper as desired. Wade Instrument Co., 1663 E. East 118th Street, Cleveland, Ohio.

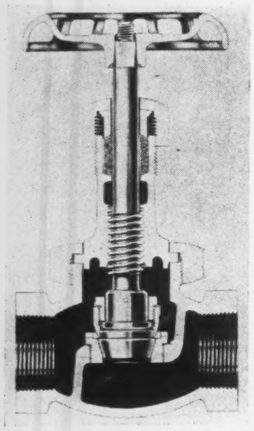
New Water Circulator



The Minneapolis-Honeywell Regulator Co., Minneapolis, Minn., has introduced a new Water Circulator — packless sealed and precision built. This Water Circulator is used to speed up circulation on hot water heating systems. It may be used alone for this purpose, or in conjunction with a Minneapolis-Honeywell Flow Valve to provide fully automatic summer-winter hot water control. The new Minneapolis-Honeywell Water Circulator is quiet in operation . . . leak-proof due to the outstanding M-H Packless Seal which does not permit the oil to enter water or vice versa . . . standard with built-in thermal overload cut-out . . . is precision built . . . high powered . . . has a high starting torque . . . requires only low starting current . . . and offers no radio resistance. This Circulator is designed to provide maximum capacity at minimum wattage input—has stainless steel drive shaft and bearings of high grade bronze. Installation is simple and very inexpensive. The Minneapolis-Honeywell Circulator is scientifically lubricated to insure trouble free performance. The long lasting oil supply can readily be renewed by the home owner. It is offered in sizes to fit 1 inch, 1½ inch, 2 inch and 3 inch pipe mains. Although 110 volts, 60 cycle motors are standard, the Circulator is available for 220 volts, 60 cycles and 110 or 220 volts, 25, 30, 40 or 50 cycles, or for 115 or 230 volts D.C.

New Valve Seat Introduced by Jenkins Bros.

Jenkins Bros., 80 White Street, New York, N. Y., has just announced its Fig. 976 Plug-Seat Valve that features a plug and seat ring made of Jenkins JX500, a superior stainless steel having a Brinell hardness in excess of 500. This valve is specially recommended for severe service such as continuous throttling for pressure reduction or free blow duty such as soot blowers, injectors, heating coils, or any steam line where close regulation is required. Jenkins states that their JX500 plug and seat practically nullify wear and almost entirely eliminate danger of wire drawing and cutting.



In a folder on the Fig. 976 Valve, Jenkins Bros. answers the question—"How Hard is 500 Brinell?"—by comparison with the hardness of some substances that get into pipe lines. They list boiler scale, pipe chips, welding heads, rust tubercles and iron oxides as under 500 Brinell, therefore not able to even scratch this new Jenkins valve seat. By contrast, a common nail is shown to be under 200 Brinell hardness.

• BUSINESS CHANGES

Pangborn Adds to Dust Control Staff

Following the announcement that Pangborn Corporation of Hagerstown, Maryland, had taken over the Dust Collecting interests of the Blaw Knox Company of Pittsburgh, Pa., comes a second news release of interest to industry in general. M. I. Dorfan, former manager of the Blaw Knox Dust Division, has been reemployed by the Pangborn Corporation to act as general field representative under the title of Dust Control Specialist.

In addition to being a registered professional engineer in the state of Pennsylvania, Mr. Dorfan is an active member of the A.S.M.E. and the A.S.H.V.E. He has served on several important engineering and dust committees, one of which was that of establishing the national standards of Exhaust System Designs—the A.S.A.

To facilitate speed of service to the entire dust field, Mr. Dorfan will contact interested prospects with dust problems from Pangborn offices in the Chamber of Commerce Building, Pittsburgh, Penna.

Wilson Joins Climax Molybdenum

Ralph L. Wilson, formerly Metallurgical Engineer of the Timken Steel & Tube Division of the Timken Roller Bearing Company, has become associated with the Climax Molybdenum Company in the capacity of Metallurgical Engineer in its development field.

A graduate from Lehigh University in 1921, Mr. Wilson served on the metallurgical staff of the United Alloy Steel Corporation from 1921 to 1926 and with their successors the Central Alloy Steel Corporation until 1928. He then was appointed Assistant Metallurgical Engineer of the Timken Steel & Tube Company, becoming Metallurgical Engineer of the same Company in 1933.

Mr. Wilson has been active in A.S.T.M. Committees on steels for service at elevated temperatures for many years. He is a member of the Refining Division of the American Petroleum Institute, and a Trustee of the American Society for Metals. He is author and co-author of numerous articles and technical papers dealing chiefly with the metallurgy of steel for high temperature applications.

Headquarters for Mr. Wilson will be in the Canton, Ohio, office of the Climax Molybdenum Company. He will devote much of his time to furthering the development of suitable steels for elevated temperature service in oil refineries and also for boilers.

New Arc Welding Supply Service in Detroit

A new service organization with warehousing facilities which will provide prompt supply service of arc welding machines, electrodes and accessories, has been established in Detroit.

The new organization is to be known as the Robinson Welding Supply Co. and was formed by J. M. Robinson who, for the past twelve years, has been Detroit district manager for The Lincoln Electric Company.

Mr. Robinson is a graduate in electrical engineering from Georgia Tech. During the time he has served Detroit welding users, he has made a host of friends. His extensive knowledge of arc welding combined with long experience assisting industrial firms in the application and use of the process in manufacturing, construction and maintenance, will be invaluable in analyzing and filling the needs of customers.

The Robinson Welding Supply Company will handle Lincoln Electric Co. products exclusively including "Shield-Arc SAE" welders, the company's well known electrodes and latest developments in arc welding accessories and supplies, together with "Linc-Weld" motors. The company will be located at 1921 E. Ferry Street, Detroit, telephone Plaza 8380.

Emerson Made New York Sales Manager of The Babcock & Wilcox Tube Company

The Babcock & Wilcox Tube Company, Beaver Falls, Pa., announces the appointment of Edward D. Emerson as New York Manager of Domestic and Export Sales. Mr. Emerson was formerly with Jones and Laughlin Steel Corp. and Air Reduction Sales Co.

New Linde Office

The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, has signed a contract for the occupancy of a new, fireproof office building at 729 North Pennsylvania Street, Indianapolis, Indiana. The new building, a two-story structure, is to be ready for occupancy on or about November 1, 1937, and will provide space for the Linde District Office and a repair and service station for Oxweld oxy-acetylene welding and cutting apparatus.

The new building will be of attractive brick and limestone construction. When it is completed, the Linde office, now located at The Prest-O-Lite Company, Inc., Speedway plant outside Indianapolis, will be trans-

Continued on Page 20

REEVES
ENGINEERING SERVICE
in Action...

Example
Reported by
E. S. Redmerski,
Reeves engineering staff, New York.

REEVES
REEVES

E. S. Redmerski, Reeves Pulley Co., of N. Y. Inc., Graduate of Newark College of Engineering. Fourteen years in mechanical engineering, eight exclusively in variable speed transmission work.

How REEVES engineering skill plus the *complete* line of REEVES Speed Control equipment get results for any manufacturer is illustrated by this example reported by E. S. Redmerski, one of the eight sales engineers on our New York staff:

"A textile machinery manufacturer in developing a new tape finisher, asked us to recommend the best method of providing adjustable speeds. He wanted his new machine to have all the speeds required by different materials and finishes, changes in weather, production schedules and other variable factors.

"For accomplishing the desired results, we chose from the complete line of REEVES Speed Control equipment two vertical enclosed design Transmissions and engineered the hook-up pictured here. Vertical design Transmissions saved space. The larger motor-driven Transmission drives the entire machine at any required speed over a 4:1 ratio. The smaller Transmission, driven direct through flexible coupling from constant speed shaft of larger REEVES, in turn drives horizontal drying section through coupling and speed reducer, synchronizing this section perfectly with main section. The result is maximum production, uniform quality under every operating condition."

Men who sell REEVES Transmissions, Vari-Speed Motor Pulleys and Motodrives are primarily *engineers.* All are factory-trained. Many are graduates of leading technical schools. A large majority devote their entire attention to engineering successful applications of variable speed control. And with a complete line of speed control equipment from which to choose—a line built around three distinct, basic units—they are in a position to recommend the ONE best unit for your individual needs. Is it any wonder that their customers rely on their judgment and advice? This unequaled service is available to you—without obligation.

REEVES SPEED CONTROL

REEVES PULLEY COMPANY, DEPT. G-117 COLUMBUS, IND.
Send FREE copy of latest edition of your Speed Control Handbook which illustrates and describes the complete REEVES line and its use throughout industry.

NAME..
COMPANY...
ADDRESS..

• Keep Informed . . .

Continued from page 18

ferred to the North Pennsylvania Street location in order to facilitate the handling of increased business activity in the Indianapolis area.

The transfer of the Linde office is necessitated by the increase in the use of oxy-acetylene welding and cutting in the Indianapolis area. The new office will serve as a center of Linde operations covering an area the radius of which is roughly 125 miles, extending from Louisville on the South to South Bend on the North and from Columbus and Cincinnati westward to Illinois.

Electromet Contracts for Wilson Dam Power

Electro Metallurgical Company, Unit of Union Carbide and Carbon Corporation, 205 East 42nd Street, New York, N. Y., has contracted to purchase from the Tennessee Valley Authority a large block of industrial power which it proposes to use at a new plant to be located in the Wilson Dam, Alabama, area. The contract will run for a period of 20 years, unless a 90-day option to cancel is exercised by the company.

The contract requires that the Authority be prepared to furnish as much as 40,000 kw. of power by 1941 should the company conclude to utilize such amount. The company will furnish its own transmission line to the boundary by the Tennessee Valley Authority property in the Wilson Dam area, where the delivery of the power will be made.

The proposed plant will be constructed principally for the manufacture of ferro-alloys, calcium carbide, and other electric-furnace products.

• LATEST CATALOGS

New A-C Turbo-Generator Bulletin

Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, announces a new bulletin No. 1180 covering condensing reaction type turbo-generator units of 1500 KW to 5000 KW capacity. This bulletin treats both turbine and generator construction in considerable detail. Photographs and drawings illustrate separation of oil and steam piping to eliminate possibility of oil fires, new combined journal and Kingsbury thrust bearing, separate steam chest, four bearing construction and simplicity of the governing system.

New Telemetering Bulletin

Typical examples of telemetering and remote control by means of Bristol's Metameter are shown in this new publication by The Bristol Company, 21 Bridge Street, Waterbury, Connecticut. It explains in diagrammatic form how these instruments measure, transmit and record readings over a simple two-wire circuit where the transmitter and receiver are any distance apart.

Bristol's complete line of Metameter telemetering instruments for recording or indicating at a remote point from the measuring element include those for transmitting pressure, liquid level, flow, temperature, mechanical motion, electrical units and totalized power load. By means of Bristol's Metameter Controllers, pressure, liquid level, flow and temperature are controlled at a point remote from that at which the measurement is made. Bulletin No. 490 gives interesting details regarding these types of installations.

New Johns-Manville Industrial Products Catalog

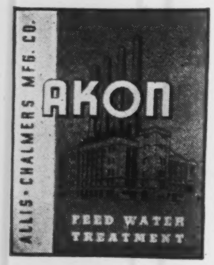
The new 1937-38 edition of the Johns-Manville Industrial Products Catalog is now available. This 64-page book, profusely illustrated, contains a wealth of information and recommendations on high and low temperature insulations for every industrial need; specifications on J-M Bonded Asbestos Built-Up Roofs, and J-M Insulated Roofs; detailed information on J-M Corrugated Transite for roofing and siding; on J-M industrial friction materials; on Transite Electrical Conduit and Korduct, Asbestos Ebony and other J-M electrical materials; on Transite Pressure Pipe for industrial and municipal water lines; on Transite industrial vent pipe and stacks; and on J-M packings and gaskets.

The catalog also describes in detail J-M Industrial Flooring Plank, Asphalt Tile Flooring, Steeltex Floor Lath, Welded Wire Reinforcement and materials for sound control of mechanical equipment.

New Feedwater Treatment Bulletin

Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, has just issued a new 16 page bulletin No. 1542 on Feedwater Treatment. It describes the application of Akon in connection with various water treating problems and contains some of the latest developments in the treatment of water for steam generation.

The subject of water treatment is divided into several components which include; scale prevention, elimination of carry-over, and the prevention of corrosion. The principles involved in the correction of the various difficulties are explained in considerable detail and the method in which Akon may be applied to eliminate these difficulties is clearly explained.



Of particular importance is a very complete discussion on the elimination of silica scale deposits in high pressure boilers, as well as a description of the use of a conductivity meter to determine the amount of boiler water solids carried over with the steam. Under the heading of "Corrosion" there are some new developments in eliminating the effect of copper in high pressure boilers. Included in the bulletin is a discussion relative to the use of Akon as a supplementary treatment following external softeners which has found application in a large number of industrial plants. The bulletin concludes with a discussion of testing equipment which has been developed for power plant service.

Modern Turbines to Reduce Costs

Recent developments in higher steam pressures and temperatures, in boiler and combustion equipment, in steam turbines and in the application of exhaust and bled steam, and how these have all combined to make possible great economies in the generation of power and heat for buildings and industrial plants, is the theme of a 12-page, 11 × 16 in. brochure entitled "Modern Turbines to Reduce Costs," issued by the De Laval Steam Turbine Co., Trenton, N. J. Cheaper fuels can be now be burned with less labor and with higher efficiency and much more power can be generated from a given weight of steam than formerly. Less building space is required, or increased demands for power can be met without increased costs for buildings and foundations. In many cases existing equipment, if in good condition, can be retained by superposing a high pressure boiler and turbine, the latter exhausting into the present steam mains. Engineers and owners of steam plants may study with interest and profit the great variety of steam turbine applications which are set forth in the text and illustrations of this publication, which will be sent free upon request.

Duravalves

Hancock Valve Division, Manning, Maxwell & Moore, Inc., Bridgeport, Conn., has just published a 4 page illustrated bulletin describing the distinctive new Hancock Duravalve, the distinctive new valve with leak-proof integral Stellite seat developed expressly for high pressure, high temperature service.

Larger Hard-Facing Booklet

A new and more complete edition of the booklet, "Hard-Facing with Haynes Stellite Products," is now being issued by Haynes Stellite Company, Kokomo, Indiana, a Unit of Union Carbide and Carbon Corporation. This booklet described well over 500 money-saving applications of the hard-facing process.

This new edition is the fourth printing since the booklet was originally published a little more than three years ago. Over 35,000 copies have already been distributed. New sections present information concerning special Haynes Stellite J-Metal cutting tools and the corrosion-resistant Hastelloy alloys. A number of examples of hard-facing automotive and aircraft valves and valve seat inserts, and the use of Haynes Stellite trim for high-temperature, high-pressure steam valves, are now also described in detail.

COMING MEETINGS AND EXPOSITIONS

For the next three months

NOVEMBER

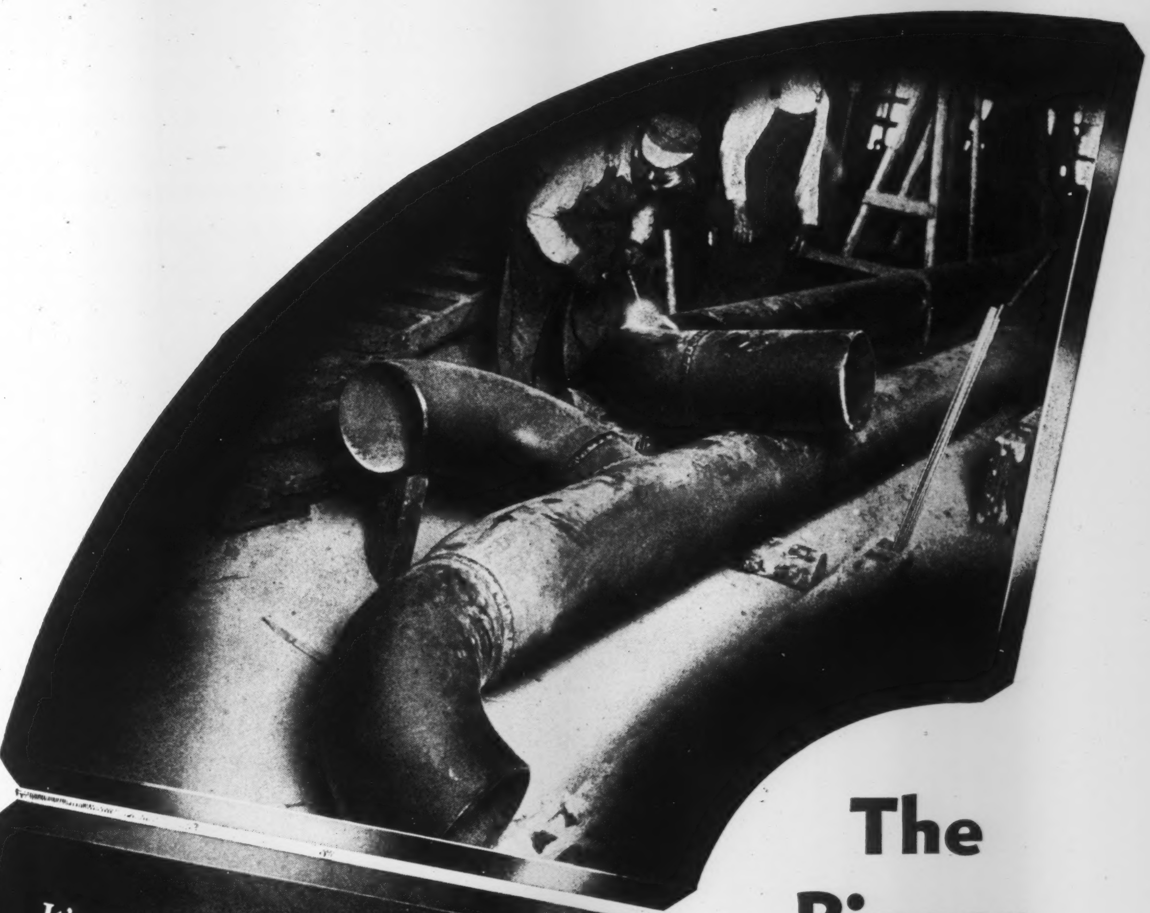
9–12	American Petroleum Institute, 18th Annual Meeting, Stevens Hotel, Chicago, Ill.
17–19	American Institute of Chemical Engineers, 30th Annual Meeting.
18–19	Society of Naval Architects and Marine Engineers, Annual Meeting, Waldorf-Astoria, New York, N. Y.

DECEMBER

6–10	**American Society of Mechanical Engineers, Annual Meeting, New York, N. Y.**
27– Jan. 1	American Association for the Advancement of Science, Winter Meeting, Indianapolis, Ind.

JANUARY

10–14	Society of Automotive Engineers, Annual Meeting and Engineering Display, Book Cadillac Hotel, Detroit, Mich.
19–22	American Society of Civil Engineers, Annual Meeting, New York, N. Y.
24–26	Institute of Aeronautical Sciences, Annual Meeting, Columbia University, New York, N. Y.
24–28	American Institute of Electrical Engineers, Annual Winter Convention, New York, N. Y.
24–28	American Society of Heating & Ventilating Engineers, Annual Meeting, Hotel Biltmore, New York, N. Y.
25–27	American Society of Refrigerating Engineers, 33rd Annual Meeting, Roosevelt Hotel, New York, N. Y.



The Bigger the Job, *the More You Need* TUBE-TURNS[★]!

It's no mere accident that most big welded-piping jobs are *Tube-Turn jobs.* Where hundreds of fittings must be welded into the lines, the installation economies of Tube-Turns mount to important proportions. And where hundreds of fittings must share in the final performance of the system, the *uniform dependability* of Tube-Turns makes their use a virtual necessity. . . . Yes, it is true that *any* fittings can make these claims. If you want *proof,* write today for Catalog 107. It gives the *reasons* for these facts. . . . Tube-Turns, Incorporated, Louisville, Ky.

★ The word "Tube-Turn" is NOT a necessary general trade name for welding fittings. It is the registered trade-mark for the products made by Tube-Turns, Incorporated, under their patents.

"NOT A MOMENT OF
Delay-
NOT A PENNY OF
Cost"

TEN impressive words from the letter of a customer whose large plant is isolated by miles and days from sources of replacement parts—and whose equipment is so generally operated by Cleveland Worm Gear Drives that the failure of even a single unit might have tied up the whole plant.

But *didn't!* His "Clevelands" had been installed 8 years previously and still showed no effects of wear when he wrote the above.

Studying the performance records of thousands of other Cleveland Worm Gear Speed Reducers installed 10, 15 or more years ago in a wide range of industries reveals that this type of report is rather usual, not at all exceptional.

To install Cleveland Worm Gear Speed Reducers in the machine equipment you design and build is to assure quiet but reliable delivery of power for almost indefinite years to come; and to enhance your customers' satisfaction.

Ask nearby District Representative for newest data on "Clevelands"—the worm gear speed reducers that serve indefinitely with "not a moment of delay—not a penny of cost."

The Cleveland Worm & Gear Company, 3264 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

CLEVELAND WORM GEAR Speed Reducers

The *Standards* COLUMN

News of Interest to Manufacturers

Single-Point Cutting Tools

An important element in every standards publication is the terminology and accompanying definitions. This element was considered so important in the case of single-point cutting tools that the originating committee decided to develop this part of the project first and to recommend its approval and publication before beginning work on the proposed standard itself.

Mr. Fred H. Colvin, Editor, "American Machinist," McGraw-Hill Publishing Co., New York, N. Y., is serving as chairman of the committee and has been ably assisted in the work by Prof. O. W. Boston, Director, Department of Metal Processing, University of Michigan, Ann Arbor, Mich. The committee was organized in December, 1933, as Technical Committee No. 19 of the Sectional Committee on the Standardization of Small Tools and Machine Tool Elements (B5) of which Mr. W. C. Mueller, Manufacturing Engineer of the Western Electric Co., Chicago, Ill., is chairman.

In beginning its work Technical Committee No. 19 made good use of material developed by Technical Committee No. 17 on Nomenclature of which Prof. Boston is chairman. However, it supplemented the definitions received from that source by others which were gathered by means of correspondence with those particularly interested in this subject. Then one of the earlier drafts of this proposal was checked by means of a questionnaire.

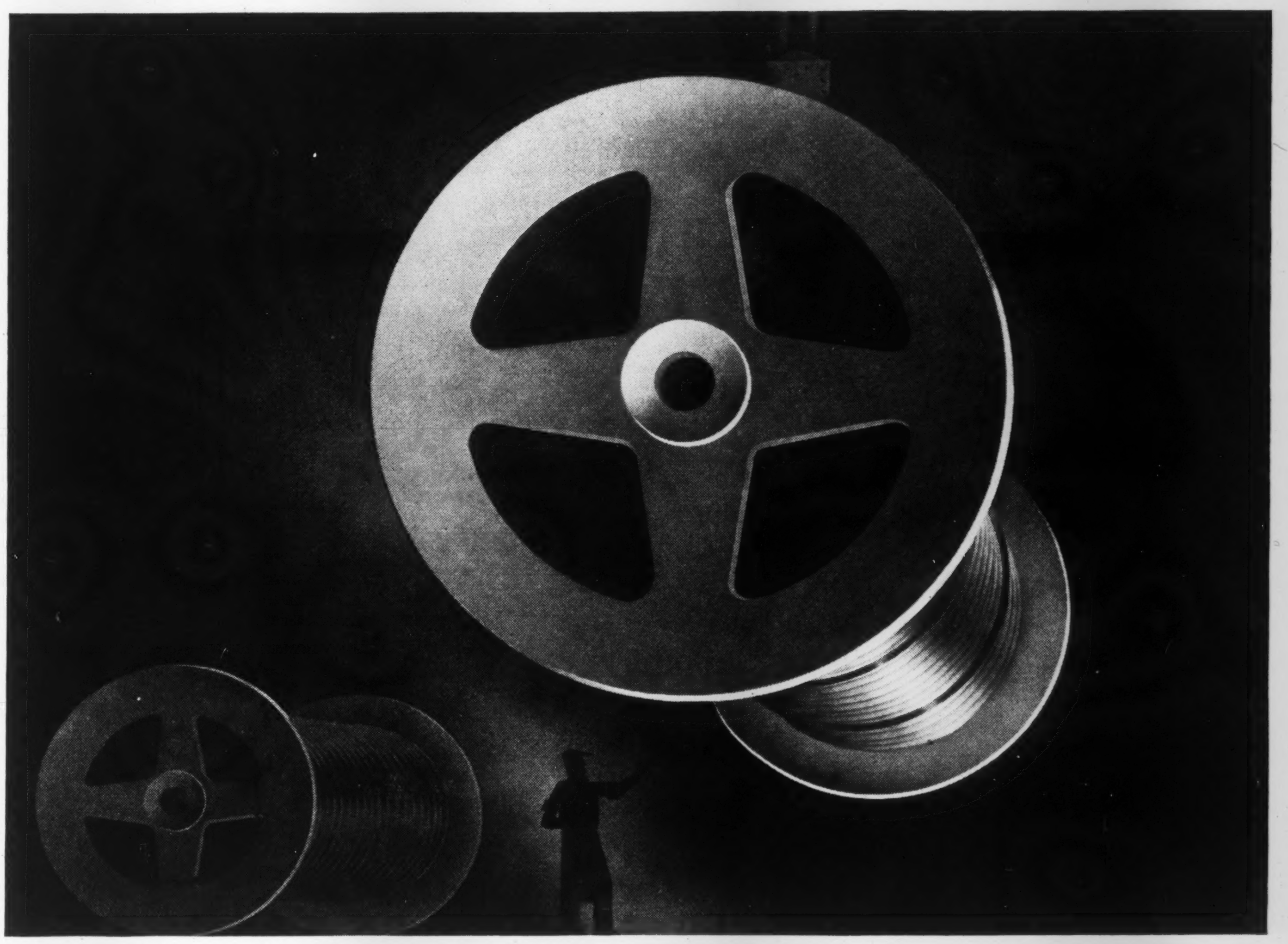
The terms and definitions in this proposed standard are divided into six groups. These are Tool Elements, Types of Tools, Tool Angles, Working Angles, General Terms, and Tool Symbols.

Coincident with the activity of Technical Committee No. 19 a subcommittee of the ASME Special Research Committee on Cutting of Metals was at work on the text of a Manual on Metal Cutting Data. Of necessity the activities of these two committees overlapped and compromises in the case of certain definitions were reached as the result of special conferences arranged by the officers of the sectional committee and the sponsor societies.

This proposed American Standard is now before the National Machine Tool Builders' Association, the Society of Automotive Engineers, and The American Society of Mechanical Engineers for review, approval, and transmission to the American Standards Association.

For further information—address

**The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.**



Cutting down reject percentages in difficult castings

● THE difficulties ordinarily encountered in bringing large castings of varying sections safely out of the mold have been strikingly demonstrated in one foundryman's experience with hoisting drums. With the usual carbon cast steel, the spokes had a tendency to pull away from the drum on cooling. Cracks and breaks brought the rejects to a discouraging percentage.

● By the simple addition of Molybdenum, the solution was found. The better casting qualities of Moly cast steels are explained in this now widely recognized technical fact: The expansion of steel, cooling through the transformation point, is virtually eliminated by the addition of Molybdenum. The effect reduces the likelihood of cracked castings, especially in those having radical differences in section.

Our technical book, "Molybdenum," contains practical data on Moly irons and steels. It will be sent on request — as will also our monthly news-sheet, "The Moly Matrix." Be free to consult our laboratory on special ferrous problems. . . . Climax Molybdenum Company, 500 Fifth Avenue, New York City.

PRODUCERS OF FERRO-MOLYBDENUM, CALCIUM MOLYBDATE AND MOLYBDENUM TRIOXIDE

MOLY

Climax Mo-lyb-den-um Company

•Keep Informed . . .

Available literature may be secured by addressing a request to the Advertising Department of MECHANICAL ENGINEERING or by writing direct to the manufacturer and mentioning MECHANICAL ENGINEERING as the source.

Announcements from advertisers in MECHANICAL ENGINEERING and the MECHANICAL CATALOG

• NEW EQUIPMENT

Plastic-Molding Presses Are Equipped With Strip Heaters

Thermostatic control of strip heating units made by General Electric Co., Schenectady, N. Y., installed in the platens of plastic-molding presses has resulted in better quality, more satisfactory operation, and lower costs for the Ward Plastics and Rubber Company of Ferndale, Michigan. Six strip units are used in each of the two platens of the presses to maintain constant heat in the areas where it is needed.

A separate thermostat controls the heating elements in each platen. With this arrangement it is possible to maintain a higher temperature in the larger radiating area of the top platen than in the smaller bottom platen. This results in a better product and has proved to be a most satisfactory feature of the installation—a feature made possible by the ease of control. Approximately 8 kw of heating units are connected in each press.

New Drinking Fountains for Factory and Office

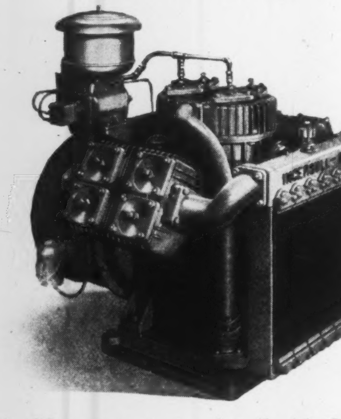
Factory and office building managers, perpetually faced with the problem of drinking fountain installations as contributions to the health, comfort and efficiency of employees, will be interested particularly in six new drinking fountains just brought out by Crane Co., 836 South Michigan Ave., Chicago. They are made of vitreous china and sculptured in a modernistic, easy-to-keep-clean design that is both rugged and attractive.

The Erie line is offered in three new models. One of these with integral strainer is equipped with two bubblers, automatic stream regulators and improved self-closing valves and loose key stops. Other new Erie fountains include a single bubbler with a push-button, self-closing ice water faucet and also a combination bubbler and ice water faucet with glass receptor. The new Ontario fountain with two bubblers is similar to the Erie except that it is of the roll rim type supported on rackets.

There are two fountains in the Oasis model. They are of unusually distinctive design. The supply and waste fittings are concealed in a housing to improve the appearance and eliminate condensation. Both of the fountains have vitreous china backs, one eight inches high, the other fifteen inches. Either of these fountains can be had with ice water faucets if desired.

In all instances the bubblers are located above the rim to avoid back-siphonage.

The Motorcompressor



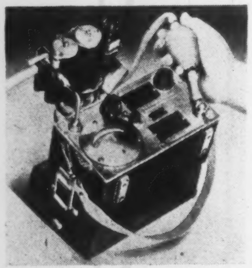
The Motorcompressor, described in Ingersoll-Rand's new bulletin No. 3166, is a stationary, vertical, single-acting, two-stage, air compressor. The intercooler and the radially-placed cylinders are air-cooled.

As the name suggests, the Motorcompressor combines the motor and compressor as a single, compact unit. The compressor crankshaft carries the motor rotor, and the compressor frame carries the motor stator. Flexible-coupling and V-belt drives are also available.

Sizes range from 15 to 75 hp. for discharge pressures from 80 to 125 lbs. per sq. in. Piston displacements range from 79 to 445 cu. ft. per min.

Copies of Bulletin No. 3166 may be obtained from Ingersoll-Rand, 11 Broadway, New York, or any branch office.

UCC Gas Indicators



The Linde Air Products Company, 205 East 42nd Street, New York, N. Y., announces a new line of gas indicators, developed for quickly and easily detecting explosive or irrespirable gas-air mixtures, the UCC Gas Indicators. These instruments are designed to fulfill the requirements of public utilities, gas plants, shipping companies, petroleum companies, paint and lacquer companies, solvent manufacturers, fire departments and insurance companies for locating underground leaks, establishing purge-end points, and determining hazardous conditions in manholes, oil tankers, oil storage tanks, holds of ships, sewers, conduits and tunnels.

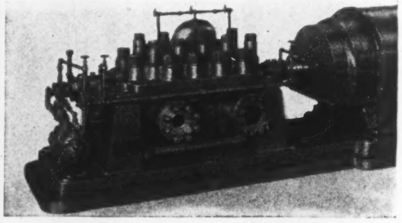
UCC Gas Indicators are available in three models. The UCC Combustible Gas Indicator Model 12-B is for the detection of combustible gases or vapors. A graduated meter scale indicates by direct reading whether combustible gases are present, and, if they are, whether concentrations are above, within, or below explosive limits. For increasing the utility of this instrument, a flame-type safety lamp attachment is available which makes it additionally possible to detect oxygen deficiencies.

The UCC All-Service Indicator Model B-1 combines three units in one. It shows the presence of combustible gases, indicates an oxygen deficiency, and, in addition, includes a toxic chamber for determining the presence of carbon monoxide and hydrogen sulphide in dangerously toxic concentrations.

Both the Combustible Gas Indicator and the All-Service Gas Indicator are equipped with a patented and exclusive air dilution valve. By means of this valve, incoming samples can be diluted with any volume of air, thus making it possible to detect flammable conditions which might not otherwise be indicated due to a lack of oxygen. It also permits following a complete purging operation from start to purge-end point with the use of inert gas as a purging medium. It is indispensable in locating underground leaks when the concentration in bar holes is above the lower limit of flammability.

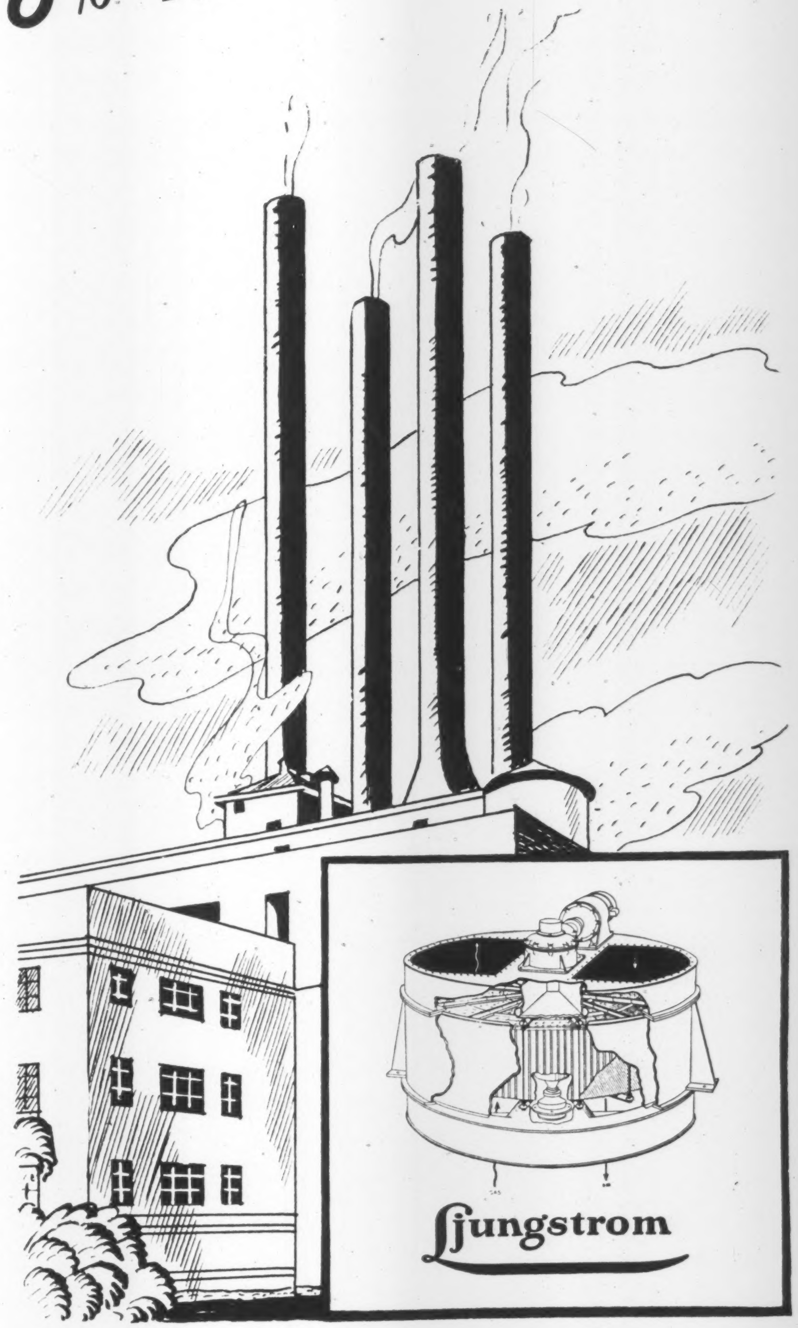
"Doubleton" Pump

Allis-Chalmers Manufacturing Co., Milwaukee, Wis., has recently introduced an improved design of multi-stage pump into the High Pressure Boiler Feed Pump field. This pump is called the "Doubleton" type because of the use of double suction impellers, and the double balance of the rotating element. The double suction impellers provide axial balance and the positions of the successive volute passages which surround each impeller are made so as to largely equalize unbalanced radial forces on the impellers. These pumps are made with horizontally split casings for pressures 1500 lbs. and above. The design and bolting has been so worked out, based on the Company's experience with bolting high pressure, high temperature steam turbine casings, that no difficulty is experienced in maintaining a tight joint and retaining the advantages of the split casing construction. This pump is also suitable for high pressure applications other than boiler feed service such as "Descaling" pumps in steel mills, oil pipe line pumps, etc.



Continued on Page 24

6%-12% Higher Boiler Efficiencies



. . . when using

PREHEATED COMBUSTION AIR

The efficiency gain is not only that indicated from drop in gas temperature through the preheater, but also includes the benefits of better utilization of radiant heat, better heat transfer, more complete combustion, and the reduced loss in combustible in the residue.

• • •

The Ljungstrom air preheater is the accepted standard for high heat recovery. Its exclusive design is responsible for one inch height of its surface being as effective as twelve inches of any other type.

THE AIR PREHEATER CORPORATION

Under Management of THE SUPERHEATER CO.

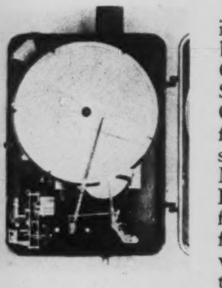
60 East 42nd Street New York, N. Y.

A-1192

• Keep Informed . . .

Continued from page 22

New Flow Meter Electric Integrator



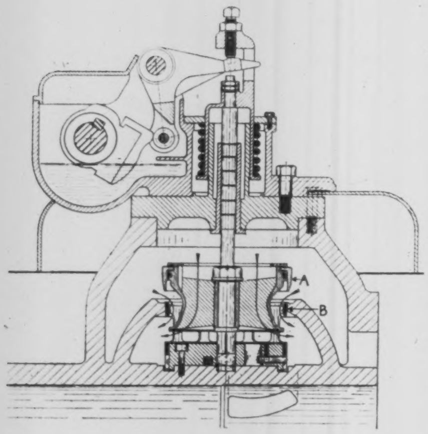
The new electric integrator developed by The Bristol Company, 21 Bridge Street, Waterbury Conn., totalizes flow once every 15 seconds. Bristol's Mechanical and Electric Flow meters, for measuring the flow of a gas or non-viscous liquid through a closed line, are now equipped with this type of integrator. A flat disc cam, shown in the figure partially concealed by the chart plate of the instrument, is specially designed to coincide with the flow law, so that it mechanically computes the square root of the differential pressure across an orifice plate or venturi tube constriction in a pipe line, at 15-second intervals. The values obtained are totalized by means of a counter and are indicated on a six-figure integrator dial. A copy of Bristol's new Catalog No. 1050, which describes this integrator, may be obtained upon request.

The New U. G. Friction Clutch

T. B. Wood's Sons Co., Chambersburg, Pa., announces an addition to their line—the new U. G. Friction Clutch. This new flexible clutch is designed for oil, gas, and Diesel Engine drives, or on drives where heavy impact is on either end. It is a combination friction clutch and flexible coupling. Descriptive Bulletin No. 380 is now available.

The "Sleeve-Poppet-Valve" Unaflow Engine

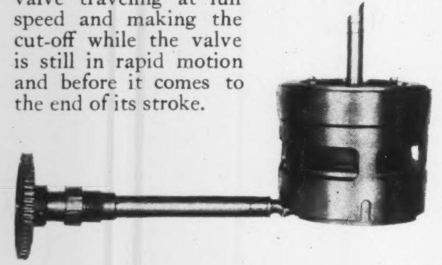
A new and simplified poppet-valve gear has been designed by the Skinner Engine Co., Erie, Pa., for variable-speed steam engines, the only addition to the regular valve gear being a sliding cut-off sleeve with ports in the periphery surrounding the poppet valve. By simply changing the elevation of the cut-off sleeve by automatic control, governing the rate of flow from a compressor or pump attached to the engine, the speed can be varied or kept constant, as desired. It also can be manually operated with practically no physical effort, which is necessary when cumbersome and heavy gears are employed.



In the cross section, Cut 1, "A" is the upper seat of a standard type expansion-compensating poppet valve used on all "Universal Unaflow" engines, the valve being in an open position. "B" is the cut-off sleeve shown in its lowest position, the lower edges of the ports in the sleeve being on the same plane with the cylinder seat for the valve. The higher the sleeve is raised, the shorter the cut-off, as the valve lift is constant and the cut-off is entirely controlled by the sleeve.

The cut-off sleeve has a loose sliding fit in the valve chest and on the valve, no attempt being made to have the fit steam-tight. It is raised or lowered by a small double crank engaging grooves in the lower end of the sleeve, the crank being extended through the steam chest and connected to a manual or automatic control. The sleeve is perfectly balanced against steam pressure.

This type of valve gear produces a sharper cut-off, as the action is similar to a sliding valve traveling at full speed and making the cut-off while the valve is still in rapid motion and before it comes to the end of its stroke.



An assembly of the valve, cut-off sleeve, and operating shaft with attached gear, is shown, the sleeve being in a somewhat raised position for an intermediate cut-off.

There will be a slight amount of leakage between the period of sleeve cut-off and the seating of the valve. However, this leakage is found to be offset by the gain in economy due to the elimination of the wire-drawing tendency of any standard cut-off gear during the short period immediately preceding the instant of seating. The cut-off, therefore, is somewhat sharper and the fullness of the card greater.

The resultant economy is shown from the tests made on a 19 x 20-in. sleeve-poppet-valve engine having a full load rating of 250 hp. with an average pressure of 135 lb. saturated steam and atmospheric exhaust:

I.hp. load	100	150	200	250
Steam per i.hp.-hr.	18.5	17.7	17.8	18.3

A considerable number of these engines are in operation in the United States and foreign countries, and this control has been used on multi-cylinder vertical as well as on horizontal variable-speed "Universal Unaflow" engines.

Spring Making Machines

The new line of Spring Making Machines which The Torrington Manufacturing Company, of Torrington, Connecticut, announced late in August of this year, has been enthusiastically received by the Trade. The Company reports that sales quota for the first six months has already been achieved. As a result, manufacturing facilities are being expanded for increased production.

• BUSINESS CHANGES

E. G. Bailey Receives Honorary Degree

Lehigh University, at its Founder's Day exercises at Bethlehem, Pa., Oct. 6, conferred the honorary degree of Doctor of Engineering upon E. G. Bailey, Vice-President of The Babcock & Wilcox Company, New York, and President of the Bailey Meter Company, Cleveland, Ohio, for "notable and distinguished accomplishment in the field of combustion and steam engineering."

In 1930 Mr. Bailey was awarded the Longstreth Medal by the Franklin Institute, and in 1936 the Lamme Medal by Ohio State University.

New Terry Representatives

The Terry Steam Turbine Co., Hartford, Conn., announces the appointment of the following new representatives who will handle the sale of Terry turbines, reduction gears and turbo-generator units in the territories indicated. C. F. Cate, P. O. Box 2037, El Paso, Texas; The Darby Corp., Kansas City, Kansas; and Ray F. Riddle, 533 Mayo Building, Tulsa, Oklahoma.

• LATEST CATALOGS

Fifth Edition of The Timken Engineering Journal

A complete revision of the General Information Section of The Timken Engineering Journal has just been completed and copies are available upon request to The Timken Roller Bearing Co., Canton, Ohio. The data presented in this 294 page loose-leaf volume which is furnished in a standard 8½" × 11" three ring binder with stiff covers includes a general discussion of the design and types of Timken Bearings now available, a discussion of ratings and bearing selection, methods used for calculating bearing loads for a wide range of fundamental applications, and complete detailed information as to bearing sizes and load carrying capacity. For the convenience of designers accurate full and half size detail bearing drawings are presented for the complete list of single row Timken Bearings up to an outside diameter of 14".

Detailed information as to standard shims for both cup and cone adjusted bearings, locknuts and washers, annular groove closures and standard tubes is included. The methods of mounting are discussed, as well as shaft and housing design and much new information is given on closures for use with Timken Bearing applications. A special section on cup and cone fitting practice is included, and specifications for lubricants for use with Timken Bearings under a wide range of conditions of load, speed and temperature are given. The information presented in this General Information Section of the Timken Engineering Journal is based on the knowledge and experience gained during the past 40 years as well as on the data secured through the elaborate research and test laboratories which the company maintains.

In addition to the revised section just released, additional supplementary sections covering applications in such special fields as conveyors, shop trucks, mine cars, farm machinery, aircraft and oil field equipment are likewise available upon request. Supplementing the data presented in the Engineering Journal and special sections, is the Timken Engineering Department which stands ready at all times to cooperate on a confidential basis and without charge or obligation, with any manufacturer who is contemplating the application of anti-friction bearings to his product or equipment.

Continued on Page 26

PICTURE TELLS THE STORY

Which is which? One flat bar is cast-iron—the other rolled steel of equal cross-section. One bar easily supports the same load that causes deflection of the other bar.*

Rolled Steel construction in this Cincinnati Shear makes possible an accuracy of a few thousandths of an inch against one-sixteenth of an inch for the old cast-iron shear. In many types of equipment where accuracy is important, rolled steel construction offers definite advantages.

Shows why Rolled Steel Construction makes machinery more rigid . . . more accurate . . . less bulky

THE greater rigidity, greater strength, lighter weight and reduced bulk obtainable by rolled steel construction are only a few of the advantages of this modern method of fabrication. Rolled Steel welded construction makes available to designers and fabricators the whole group of metallurgy's finer steels — steels specially developed to resist every destructive force — impact, wear abrasion, corrosion, heat, high pressure, vibration. It permits you to combine various steels, if necessary, into one homogeneous unit.

Here are some of these steels:

U·S·S High Tensile Steels to carry high unit stresses and reduce weight to a minimum.

U·S·S Abrasion-Resisting Steel to reduce abrasive wear and cut down replacements.

U·S·S Steel for Low Temperature Service to provide high impact strength at low temperatures.

U·S·S Heat-Resisting Steel (25-12) to endure temperatures disastrous to other metals.

Special analyses of U·S·S Carilloy Alloy Steels to carry tremendous bearing pressures safely.

U·S·S Stainless Steels to resist corrosive environments.

Remember, too, that rolled steel construction allows the inclusion of steel castings in the design wherever they prove economical. It also enables you to take advantage of a wide variety of special shapes, bars, slabs, pipe, forgings and rolled sections that help to reduce construction costs.

Write us freely about any problem which you feel might be solved by these special steels or rolled steel design.

***The rigid flat bar at the left is rolled steel. By actual test, rolled steel is about 2½ times as stiff as cast-iron.**

CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL

• Keep Informed . . .

Continued from page 24

Rotary Oil Pump

Numerous and varied uses of the unique "IMO" rotary oil pump are shown by Publication L-32-10, distributed by the De Laval Steam Turbine Co., Trenton, N. J. This pump is designed to run at ordinary electric motor and steam turbine speeds and is used principally for supplying fuel oils of all grades to burners and for transferring or circulating lubricating oils. It has three moving parts, a power rotor and two sealing rotors, but no valves, timing or pilot gears or separate bearings. The one stuffing box is subject to suction pressure only. There is no trapping of liquid pumped and pulsation or vibration is absent. The applications shown range from small lubricating pumps built into other machines to pumps supplying oil to hydraulic pressure systems at 500 lb. per square inch and Bunker C oil in large quantities to burners in central stations and on large steamships.

New James Catalog

The new catalog just issued by D. O. James Mfg. Co., 1120 W. Monroe St., Chicago, Ill., contains complete information such as Horse-Powers, Ratios, dimensions, weights and prices on Herringbone, Worm Gear, Spur Gear and Spiral Bevel Gear Reducers, also Cut Gears of all types, with very complete engineering data.

Barnes Gear Pump

W. F. and John Barnes Co., Rockford, Ill., announce their new circular describing the Barnes Gear Pump.

Yarway Water Columns and Water Gages

New revised edition of Yarway Bulletin WG 1805 has just been issued by Yarnall-Waring Co., Norwood St., Philadelphia, Pa., and gives complete details of the Yarway Floatless Hi-Lo Alarm Water Column and the Yarway line of water level gages for pressures up to 1500 lbs. This data will be useful for your technical file.

Self-Locking Hollow Set Screw

The Standard Pressed Steel Co., Jenkintown, Pa., announces a new Self-Locking Hollow set Screw which is illustrated and described in a folder just issued. The locking is accomplished by knurling two top threads. This knurling raises sharp prongs all around the edge of the thread which dig right into the threads of the tapped hole when the "Unbrako" Self Locking Set Screw is being tightened up—it can't possibly work loose—tests have proven it.

New Electric Flow Meters Bulletin

A new bulletin illustrating applications and outlining the special features of Bristol's New Electric Flow Meter, is now available for distribution by The Bristol Company, 21 Bridge Street, Waterbury, Conn. Information regarding the simplicity of construction and high accuracy of these new instruments may be obtained from this publication.

New Bulletin on Modern Pyrometers

Bristol's Modern Potentiometer Pyrometers, Recorders, and Controllers are briefly described in a new bulletin, No. 493, now available for distribution by The Bristol Company, 21 Bridge Street, Waterbury, Conn. The special features of the Pyromaster — a newly developed potentiometer with simplified operating mechanism—are outlined, together with the uses of this instrument as a Pyrometer, a Resistance Thermometer, a Tachometer, and a Millivoltmeter. Another recent development in potentiometer pyrometer design is briefly described in this publication—Bristol's Wide Strip Single and Multiple Recorders, and Recording Controllers.

A copy of Bulletin No. 493 may be obtained upon request.

Stainless Steel Electrodes

A booklet on Stainless Steel Electrodes, containing considerable information regarding the various grades of Stainless Steels and the procedure for welding them, has just been published by the Page Steel and Wire Division of American Chain & Cable Company, Inc., Monessen, Pa. A copy will be sent on request.

Conveyor Chain Goes Around Curves

An illustrated Folder No. 1651 has been published by Link-Belt Company, on No. 4250 Swivel Chain, described as a strong, durable, flexible, quickly detachable conveyor chain that will travel around curves of as small a radius as 12″. The new chain is particularly recommended for case, carton, crate and can conveyors in dairies and other bottling plants. A copy of Folder 1651 will be forwarded to any reader upon request addressed to Link-Belt at 220 S. Belmont Avenue, Indianapolis, Ind., or other office of the company.

Booklet on Timken Seamless Mechanical Tubing

For the convenience of those specifying and using seamless mechanical tubing, The Timken Steel and Tube Division has assembled a handy pocket size handbook, 4½″ × 7″, listing Standard Tolerances, mechanical properties of cold drawn carbon steel seamless tubing, theoretical weight per lineal foot of seamless tubing from $^1/_8$″ OD to $10^3/_4$″ OD and wall thicknesses ranging from .004 to $1^5/_8$″. Conversion tables and standard seamless steel pipe size tubing tubes, with a summary of standard definitions of terms used in connection with tubing specifications, are also included. Copies of this booklet may be secured free upon request to The Timken Steel and Tube Division of The Timken Roller Bearing Company, Canton, Ohio.

Adsco Water Heaters

A revised, six page, illustrated Bulletin No. 35-76 on ADSCO Water Heaters for industrial and institutional installations including the Type E heater for gravity recirculation, submerged heater and condensate cooling service and the Type F heater for maintaining suitable water temperatures to prevent the freezing of water in elevated steel or wooden tanks, is available by addressing the American District Steam Co., North Tonawanda, N. Y.

Stainless Working Methods Book Offers Unique Approach

A new technical publication by Ludlum Steel Co., 350 Armstrong Street, Watervliet, N. Y., entitled, "The Working of Silcrome Stainless Steel," links up, in a novel way, detailed instructions on methods of fabricating Ludlum Stainless with information as to the grades of tool steel best suited to each operation.

This factual data book has been prepared for the use of engineers, designers, and other technical men interested in practical working methods, to guide them in using Silcrome to greatest advantage. It contains practical advice on all the usual metal working operations, such as sawing, drilling, milling, threading, tapping; also on hot upsetting and forging, shearing, drawing, punching, spinning, brazing, soldering, welding, and the like. In addition, the book contains information on the proper selection, heat treatment, etc., of the tool steels for the various operations.

This manual, according to Ludlum, is the outgrowth of long experimentation in the laboratory, and careful study of actual production methods. This unique tying in by Ludlum of tool steel data with stainless working instructions should prove an outstanding contribution to the literature on the subject.

Polaroid and Polarized Light

An interesting booklet has just been issued by the Polarizing Instrument Co., 8 West 40th Street, New York, N. Y., on the subject of Polaroid and Polarized Light. This booklet was prepared by the technical staff of the Polaroid Corporation.

Self-Sealed Bearings

A new 20-page booklet entitled "Sealed" gives the principles involved in the N-D-Seal bearing, and the need for this type of self-sealed bearing. Numerous case histories are cited and illustrated in which N-D-Seals have been used with outstanding success. A review of accomplishments of this self-sealed lubricated-for-life ball bearing after ten years, during which time 10 million have been placed in successful use. Those interested should ask for "Booklet D" from New Departure, Division General Motors Corporation, Bristol, Connecticut.

COMING MEETINGS AND EXPOSITIONS

For the next three months

DECEMBER

6–10	**American Society of Mechanical Engineers, Annual Meeting, New York, N. Y.**
27– Jan. 1	American Association for the Advancement of Science, Winter Meeting, Indianapolis, Ind.

JANUARY

10–14	Society of Automotive Engineers, Annual Meeting and Engineering Display, Book Cadillac Hotel, Detroit, Mich.
19–22	American Society of Civil Engineers, Annual Meeting, New York, N. Y.
24–26	Institute of Aeronautical Sciences, Annual Meeting, Columbia University, New York, N. Y.
24–28	American Institute of Electrical Engineers, Annual Winter Convention, New York, N. Y.
24–28	American Society of Heating & Ventilating Engineers, Annual Meeting, Hotel Biltmore, New York, N. Y.
25–27	American Society of Refrigerating Engineers, 33rd Annual Meeting, Roosevelt Hotel, New York, N. Y.

FEBRUARY

14–18	American Institute of Mining & Metallurgical Engineers, Annual Meeting, New York, N. Y.

"RIGHT! We'll buy our Diesels from Fairbanks-Morse . . . they have more experience and a more complete line"

FAIRBANKS MORSE Diesels

DIESEL ENGINES
PUMPS
ELECTRICAL MACHINERY
FAIRBANKS SCALES
RAILROAD EQUIPMENT
WATER SYSTEMS
REFRIGERATORS
RADIOS
WASHERS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS

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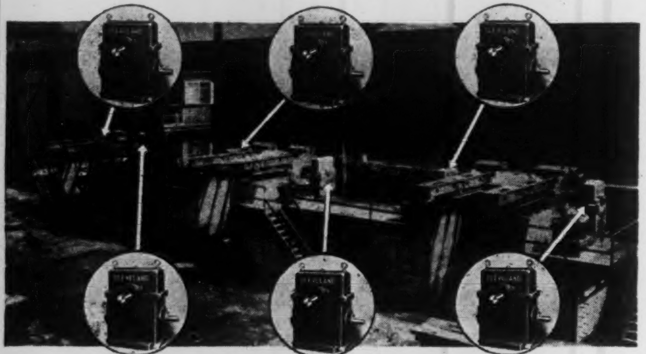
Use of CLEVELAND DRIVES increases...



During 20 Years of Improving Industrial Equipment

• During the past 20 years, Designers of equipment in the steel industry have so broadened the applications of Cleveland Worm Gear Drives and Speed Reducers that, starting from *one* use in 1917, many thousands of "Clevelands" are now serving more than 225 separate ones in Steel Mills and Blast Furnace Plants.

Within the same period, "Cleveland" has enjoyed similar increases in sales volume through other heavy industries. Such growth in demand and in buyers' confidence bears ample testimony to the fact that the continual improvement in design and workmanship by "Cleveland" has kept pace with broad developments in each industry.

The counsel of District Representatives, familiar with power-transmission requirements of principal industries, is at the service of Machine Builders. Address The Cleveland Worm & Gear Company, 3264 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval, Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication

CLEVELAND Worm Gear Drives

The Standards COLUMN

News of Interest to Manufacturers

Indicating Pressure and Vacuum Gages

Some standards have for their principal purpose the insuring of interchangability of product. Others serve the economic purpose of simplifying the variety and size of manufactured products. Still others are developed to insure uniformity of the important appearance factors, nomenclature, purchase specifications, and tests. The new standard for indicating pressure and vacuum gages falls into this last named class. As such, its primary interest is for the consumer or user group, although the manufacturers have cooperated whole-heartedly in its development.

Before recommending the initiation of this project to the American Standards Association, The American Society of Mechanical Engineers made a preliminary investigation among its members and others representing a wide range of interest. The ASA in turn held a general conference on this subject at which the societies, associations, and firms known to be interested in standardization in this field were represented. This conference confirmed the desirability of proceeding with the project. Accordingly, the organization of a sectional committee for this purpose was authorized by the ASA and the ASME was designated as the sole sponsor.

The actual development of an American Standard for Indicating Pressure and Vacuum Gages began with the first meeting of the sectional committee held in New York, N. Y., in December, 1930. Since that date several drafts of the various sections of the proposed standard have been prepared by the four subcommittees appointed to handle the different phases of the project. As these sections were completed, they were duplicated and distributed broadly to industry for criticism and comment.

The first draft of the complete proposal was released to the membership of the sectional committee on October, 1936. Printer's proof copies were reviewed prior to and at the December, 1936 meeting of the committee and certain slight changes and additions were ordered.

In its present form the proposed standard includes the following sections, Nomenclature and Definitions, General Requirements, Size and Dimensions, Dial Ranges, Dial Figures, Graduations, Indicating Pointer, Accuracy Requirements, Test Methods, Grades of Quality and Rules for Installation and Use.

The finally revised draft will be reviewed at a meeting of the committee to be held in New York, N. Y., on December 9, 1937, after which the proposed standard will be presented to the sponsor body for approval and subsequently to the American Standards Association for final approval and designation as an American Standard.

The officers of the sectional committee and the subcommittees are given below:

Melvin D. Engle, *Chairman*, Sectional Committee, Chairman, Subcommittee No. 1, Edison Electric Illuminating Co. of Boston, Boston, Mass.

Arnold W. Lenderoth, *Secretary*, Sectional Committee, Secretary, Subcommittee No. 1 on Plan and Scope, Consolidated Engine Stop Co., New York, N. Y.

C. Frank Schwep, *Chairman*, Subcommittee No. 2 on Definitions, Ingersoll-Rand Co., New York, N. Y.

Arthur Huntress, *Secretary*, Subcommittee No. 2 on Definitions, Ingersoll-Rand Co., Phillipsburg, N. J.

Herbert B. Reynolds, *Chairman*, Subcommittee No. 3 on Gage Sizes and Mounting Dimensions, Interborough Rapid Transit Co., New York, N. Y.

Alva B. Morgan, *Secretary*, Subcommittee No. 3 on Gage Sizes and Mounting Dimensions, Edison Electric Institute, New York, N. Y.

Orlando J. Hodge, *Chairman*, Subcommittee No. 4 on Accuracy and Test Methods, Bureau of Standards, U. S. Department of Commerce, Washington, D. C.

For further information—address

The American Society of Mechanical Engineers
29 West 39th St., New York, N. Y.

MECHANICAL ENGINEERING

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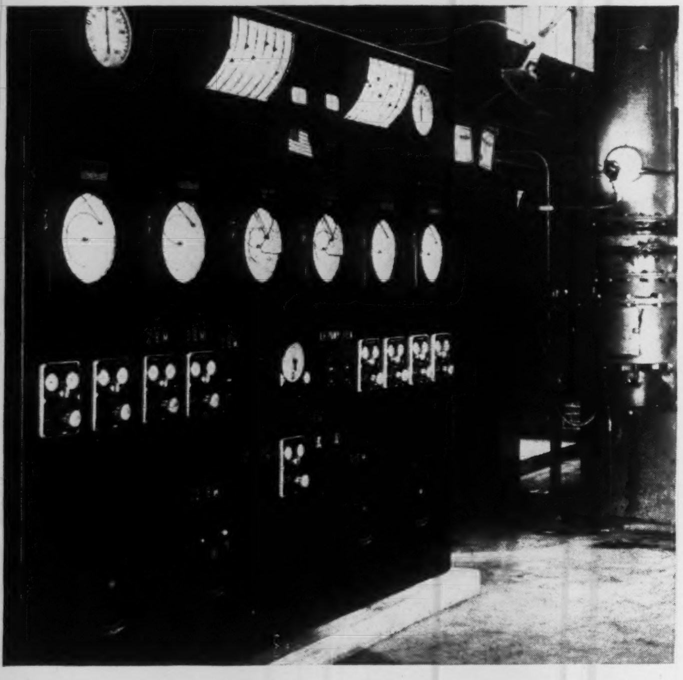
December 193



Bailey Combustion Control installed on two 80,000 lb. per hour capacity pulverized coal fired integral-furnace boilers at Libbey-Owens-Ford Glass Co., Toledo, O.

DAILY EFFICIENCIES INCREASE TO TEST STANDARDS

At Libbey-Owens-Ford Glass Co. Bailey Meter Control automatically operates steam generating equipment to maintain test economies at all times

To secure a full return from an investment in new boilers, water-cooled furnaces, pulverizers, stokers and other major equipment, it is necessary that they be operated to deliver maximum combustion economy —not only during tests, but continuously day in and day out.

At Libbey-Owens-Ford Glass Co., as in numerous other modern steam plants, this duty has been assigned to Bailey combustion control. This complete control incorporates the Steam Flow—Air Flow boiler meter as an integral part of the system so that even minute changes in fuel —air ratios are measured and automatically corrected for even as they tend to occur.

Bailey Meter Control makes possible the maintenance of boiler test standards in every-day operation because it is a complete system which (1) automatically maintains desired steam pressure; (2) automatically maintains most economical fuel—air ratio; (3) automatically maintains desired furnace draft; (4) automatically maintains division of load among boilers.

Details on this sturdy, inexpensive, air-operated control system are contained in bulletin No. 102-A. Your copy will be mailed, without obligation, upon request.

BAILEY METERS

BAILEY PRODUCTS

BOILER METERS • COMBUSTION CONTROL • FEED WATER CONTROL • PRESSURE REDUCING AND DESUPERHEATING CONTROL • SUPERHEAT CONTROL • MULTI-POINTER GAGES • SMOKE DENSITY RECORDERS • RECORDERS FOR PRESSURE, TEMPERATURE AND LIQUID LEVEL • FLUID METERS FOR STEAM, WATER AND GAS.

BAILEY METER COMPANY
1026 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada

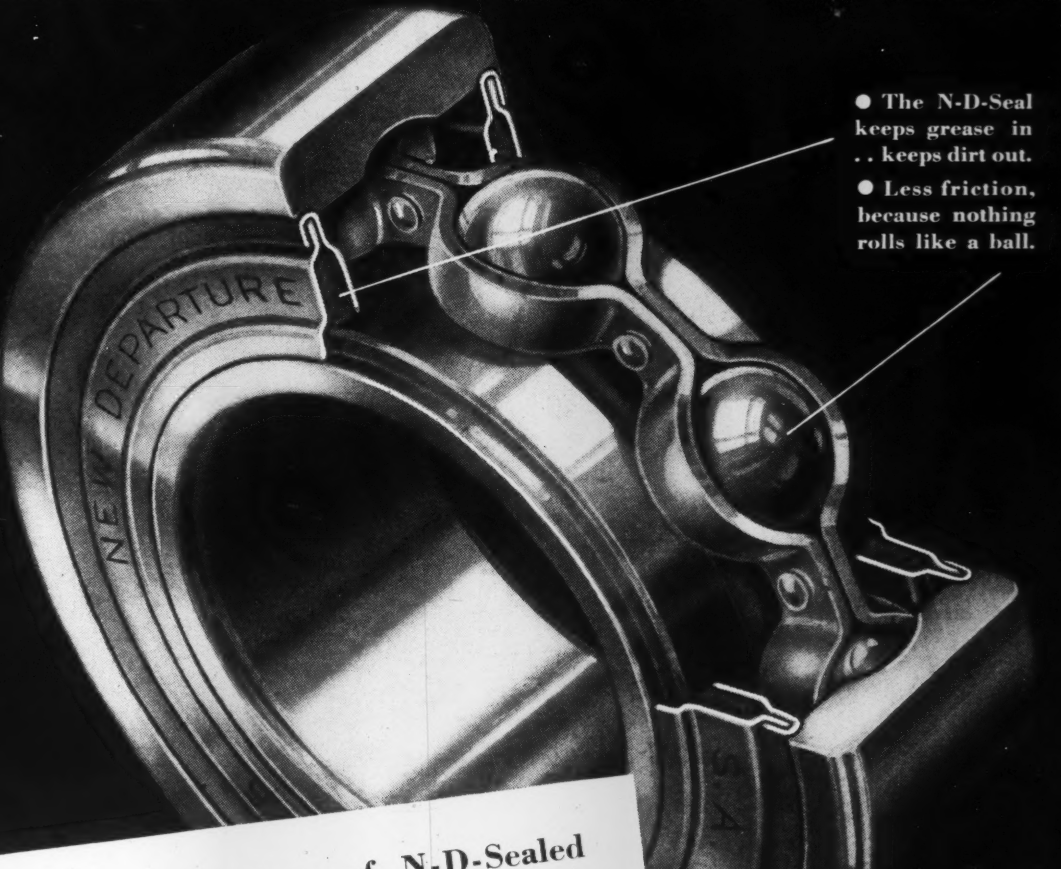
A-35-1

BAILEY METER CONTROL

The Complete Combustion Control System

NEW DEPARTURE DID IT!

...and so well 10,000,000 are now in use



● The N-D-Seal keeps grease in . . keeps dirt out.

● Less friction, because nothing rolls like a ball.

Startling success story of N-D-Sealed Ball Bearings points way to new savings for every builder and user of machines

New Departure originated self-sealed ball bearings. In 1928 the total output was 13,328 bearings . . . now there are more than ten million in use.

N-D-Seal Ball Bearings are delivered *sealed*, of course, and *lubricated-for-life*. Grease is sealed in . . . dirt is shut out!

New, money-saving applications for these bearings are being discovered every day. If you build or use machines, N-D-Seal Bearings will probably save you money. Send for booklet D7.

Nothing Rolls like a Ball

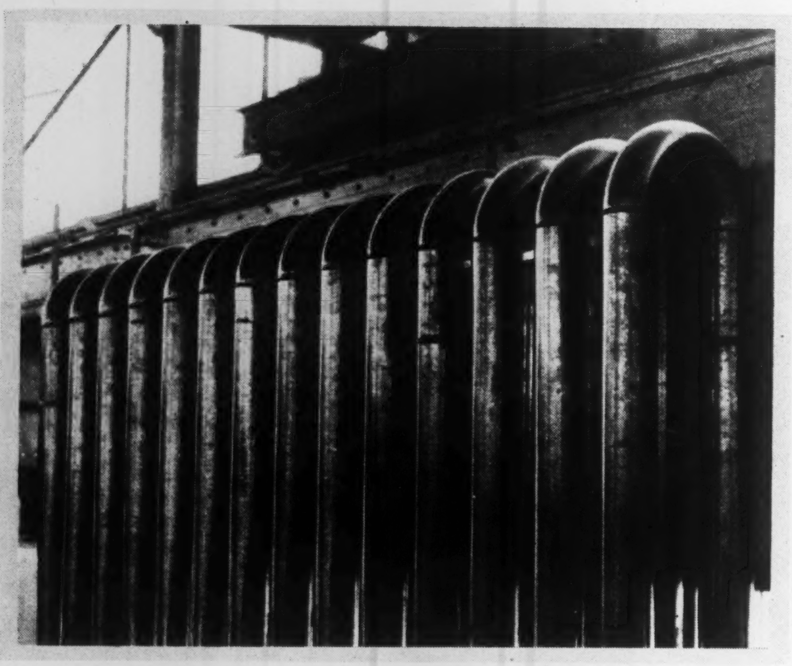
NEW DEPARTURE *N-D-Seal* Bearings

New Departure • Division General Motors Corporation • Bristol, Connecticut

NOTHING ROLLS LIKE A BALL

MECHANICAL ENGINEERING, December, 1937, Vol. 59, No. 12. Published monthly by The American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 W. 39th St., New York, N. Y. Price 60c a copy, $5.00 a year; to members and affiliates, 50c a copy, $4.00 a year. Postage to Canada, 75c additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the act of March 3, 1879. Member of the Audit Bureau of Circulations.

How WELDING—
makes Better Pipe Coils



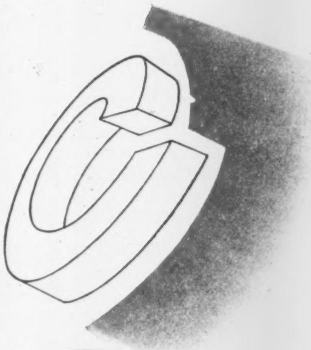
These streamlined coils, part of a cooling unit for processing chemical gases, are as efficient as they appear. Oxy-acetylene welding has formed them into a single unit, simple in design, and maintenance-free. They are permanently leak-proof and fully resistant to the corrosive action of coolants, brines and refrigerating gases.

The smooth exterior and interior walls of these welded coils, in addition to providing high flow efficiency, are easy to clean and to keep clean.

Linde engineers have utilized the benefits of oxy-acetylene welding to assist manufacturers in improving countless and varied metal products. You, also, may find it profitable to investigate this service. Ask the nearest Linde office for complete information. The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation, New York and principal cities.

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE **UNION CARBIDE**



An Invitation

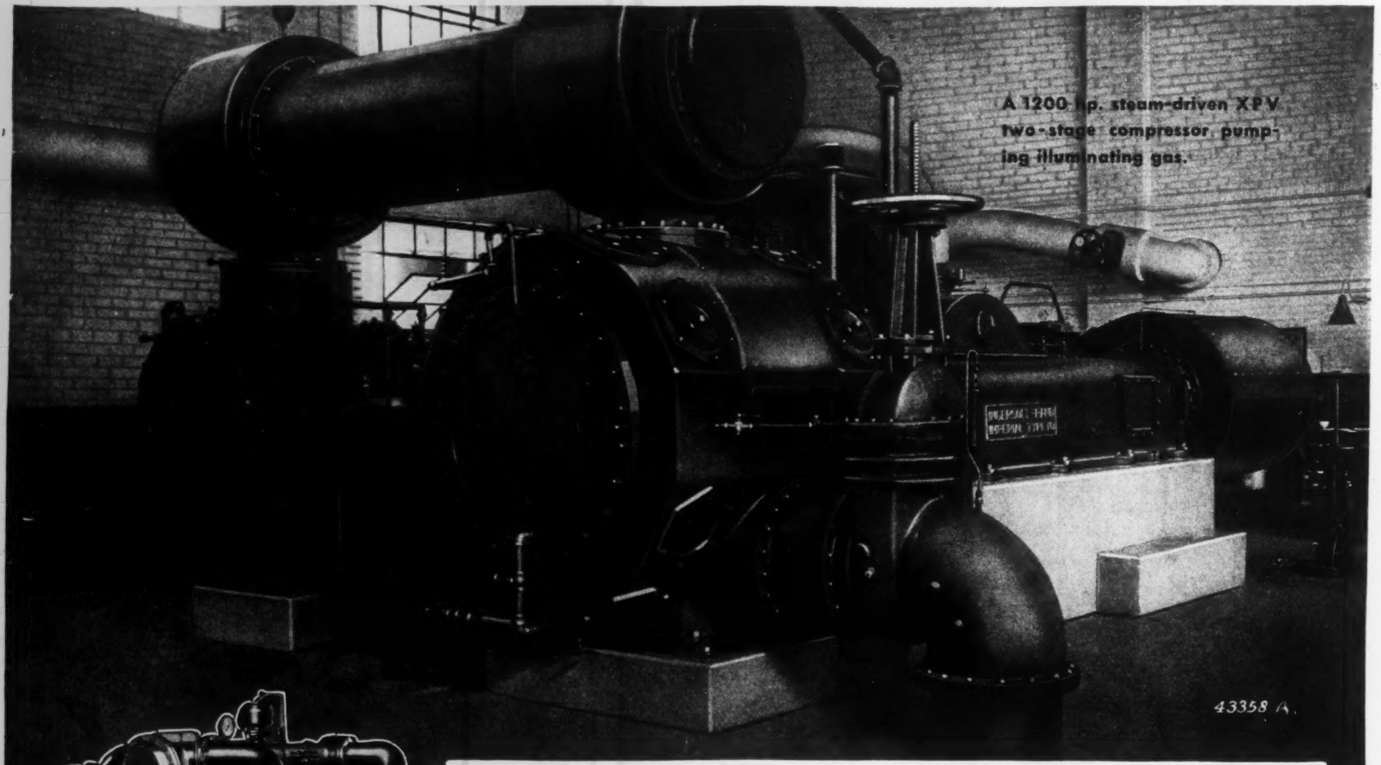
to use the only device
possessing all three essentials
indispensable to every
correctly designed bolted assembly:
Live action . . .
adequate range . . . and power.
A helical Spring Washer!

SPRING WASHER INDUSTRY

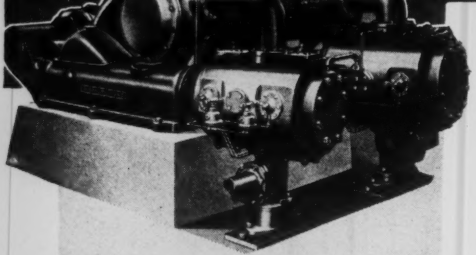
Six Sixteen Wrigley Building., Chicago Illinois

COMPRESSORS BUILT TO YOUR ORDER

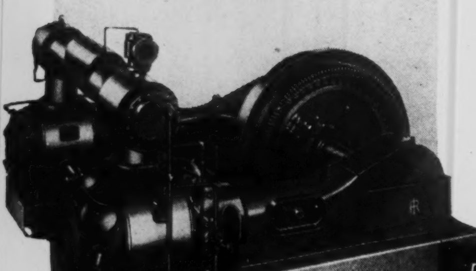
From a Wide Range of Standardized Parts



A 1200 hp. steam-driven XPV two-stage compressor pumping illuminating gas.



The belted and direct-connected electric-driven compressors shown above and below are also part of the I-R line of more than 1000 sizes and types of compressors, vacuum pumps and blowers ranging from 1/4 to 12000 hp.



TODAY, a steam-driven compressor is usually chosen to fit into existing steam-plant conditions with a view to maintaining the proper steam balance of the plant as a whole.

With this trend in mind, the XPV steam-driven compressor has been developed around a standardized set of frames and running gears. For each frame and running gear there has been developed a wide range of sizes of steam cylinders to take care of varying requirements.

Likewise, in addition to the standard 2-stage, 100-pound compressing end for each of these frames, a wide range of sizes and types of compressor cylinders is available to take care of special compressing problems—for handling air, synthetic, poisonous or inflammable gases, for vacuums, and for pressures up to 5000 lbs. There is also a complete line of ammonia cylinders, which make these machines particularly adaptable to the wide range of pressure conditions encountered in industrial applications.

The XPV is noted for its "four corner" construction affording maximum accessibility, and for its piston-valve steam end with automatic cut-off. The latter provides maximum economy under varying steam and load conditions. Double-crosshead and tie-rod construction gives straight-line drive from steam to compressor ends. Compressor cylinders are equipped with the efficient, quiet and durable Channel Valves. Each of these distinctive features was pioneered by Ingersoll-Rand.

521-1

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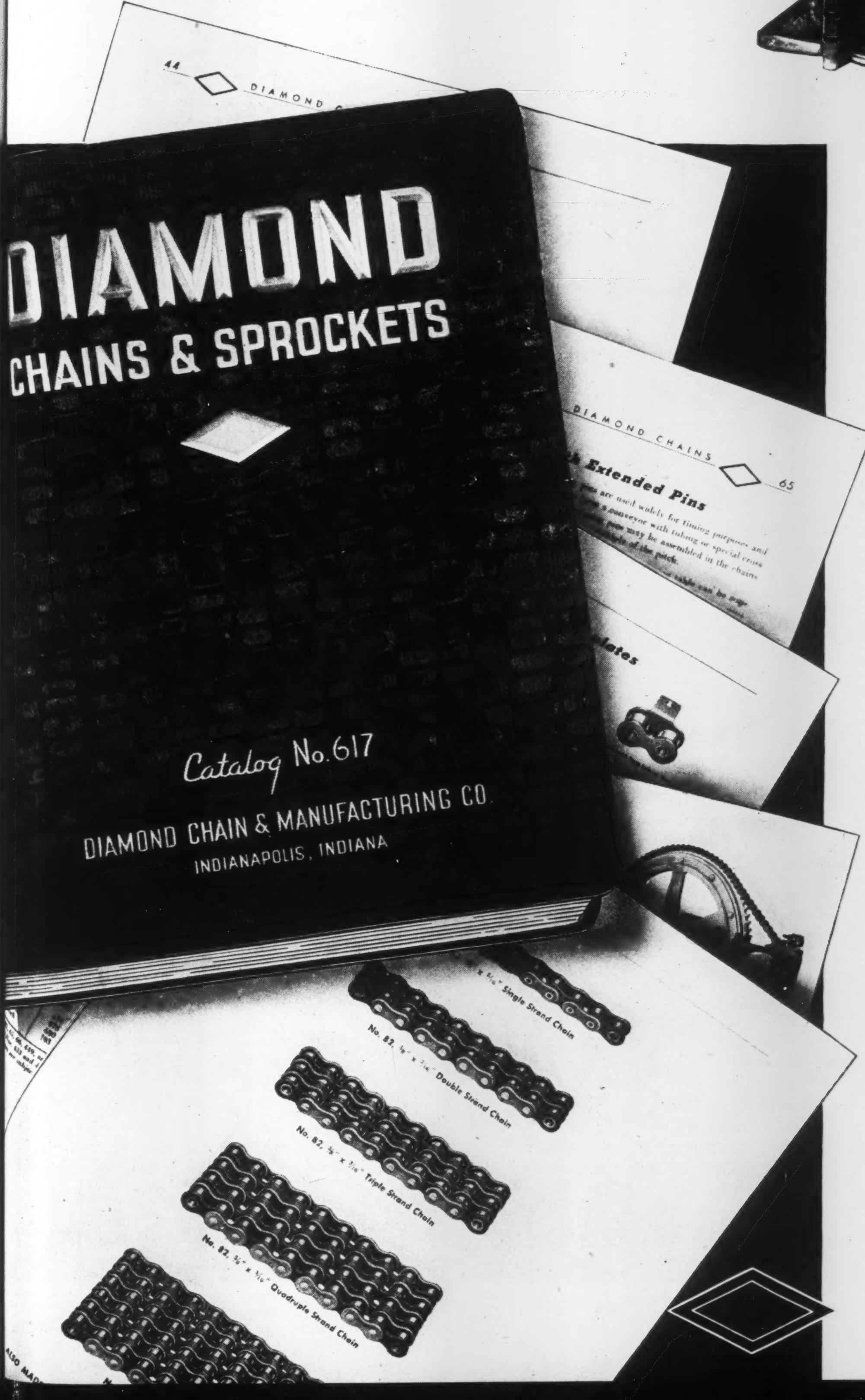
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As a builder of machinery and a user of power drives in your plant, you will find this new 100-page Catalog valuable for its usable information on power transmission.

It points out how to make the best use of the higher efficiencies that Diamond Roller Chains afford . . . Extensive "worked-out" tables give the answers to drive problems of every kind, speed and capacity—more information than has been available heretofore.

Get this new book, study your drives—apply Diamond Chain for lower power costs, increased and maintained production output, and reduced maintenance . . . Diamond is used as regular equipment on machinery of leading manufacturers and for drives in plants of highest efficiencies (over 8,000 in one plant alone). Let us mail you a copy of Catalog 617. DIAMOND CHAIN & MFG. CO., 413 Kentucky Ave., Indianapolis, Ind. *Offices and Distributors in Principal Cities.*

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Diamond Chain & Mfg. Co., Indianapolis, Ind.
Please mail copy of Catalog 617.

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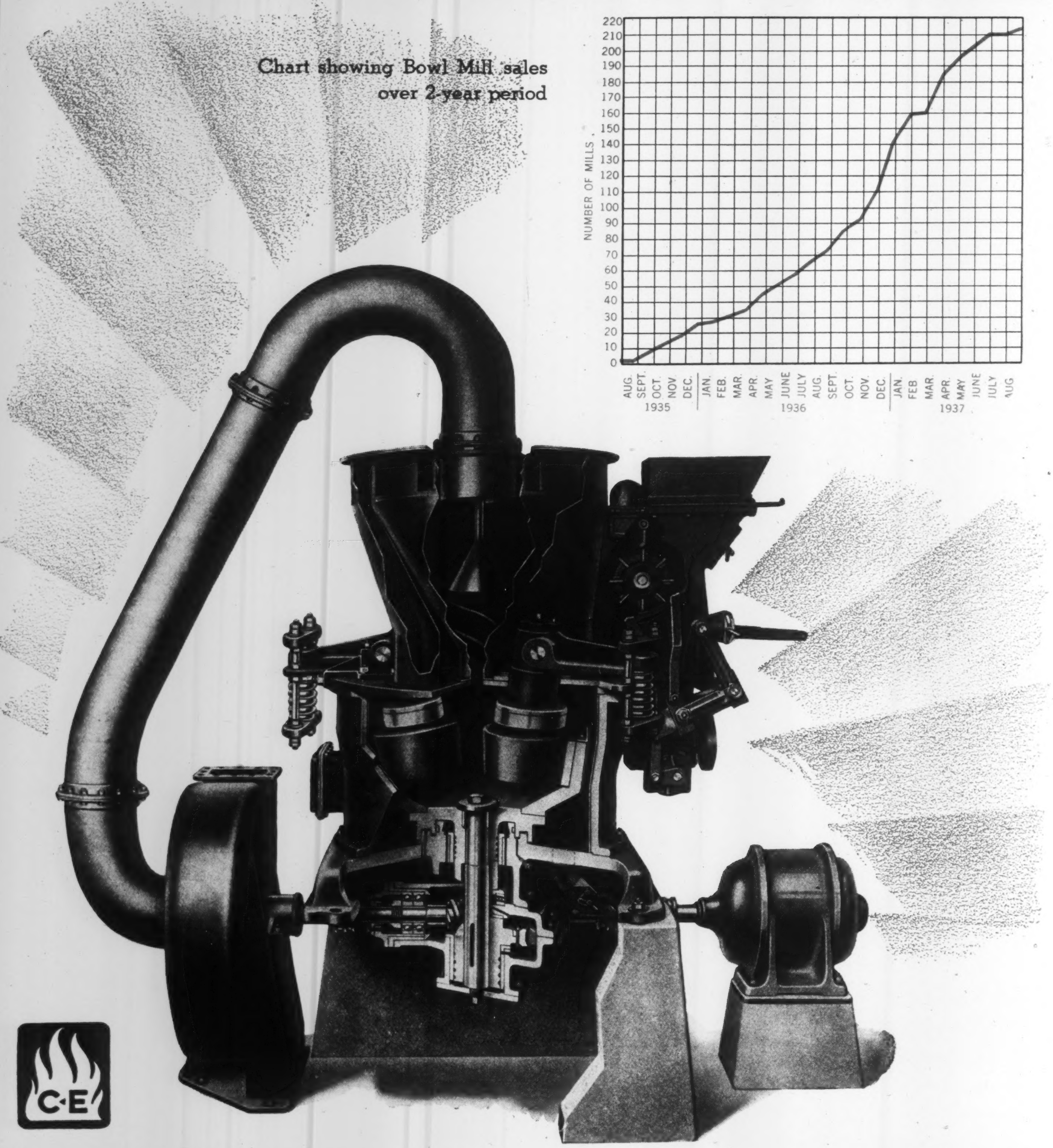
C-E RAYMOND BOWL



C-E

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS

COMBUSTION

MILL PERFORMANCE

Sets Today's Standards

The C-E Raymond Bowl Mill was placed on the market about two years ago. It was expected—based on the results obtained with a full size experimental unit over a two-year period—that the Bowl Mill would revolutionize previous concepts of good pulverizer performance. Now, after two years of commercial operation, it can definitely be said that this expectation has been fully realized.

Actual operating records show these results

Low Maintenance

(In one plant the maintenance cost for two mills, after each had ground 46,000 tons of coal, was less than one half cent per ton. In another case, where a Bowl Mill had been in virtually continuous service for 9 months, it was estimated that maintenance would average $1\frac{1}{2}$ cents per ton.)

Grinding elements can remain in use continuously without materially affecting performance, until their service life is fully utilized. Consequently, mill outage and labor costs for removal and replacements of partially worn parts are avoided.

High Continuity of Service

(The first Bowl Mill to be placed in commercial service has been in continuous 24-hr. service, 6 days a week, for over two years. Uninterrupted service over as long periods as required is characteristic of Bowl Mill performance.)

Uniform Fineness

(consistently maintained over the mill's wide range of output.)

Lower Power Consumption

(as low as 7.3 kw per ton, on a large mill grinding Pocahontas coal.)

Quiet Vibrationless Operation

(Those familiar with coal pulverizers who have observed the Bowl Mill in operation have invariably been amazed at its quietness and lack of vibration. It is unquestionably the quietest coal pulverizer on the market.)

Adequate Protection Against Tramp Iron

(The mill design provides adequate protection against injury by tramp iron. No damage by extraneous material has ever been reported.)

The confidence of buyers that the design and construction features of the Bowl Mill would assure superior performance is evidenced by the accompanying graphic record of sales. The fact that many of these purchases reflect the conclusions of leading power engineers, responsible for the selection of equipment for both large and small utility and industrial plants throughout the country, is significant of the position this remarkable mill has attained.

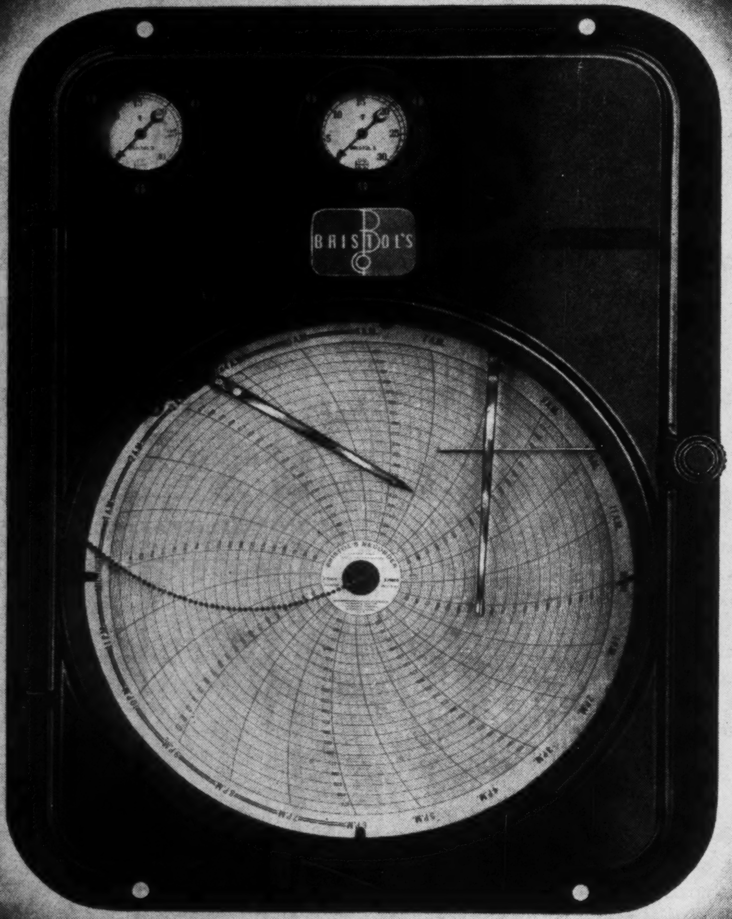
If you are considering the application of pulverized fuel firing to present or new boilers, we urge you to investigate the C-E Raymond Bowl Mill before you buy. You will then discover why the Bowl Mill is setting today's standards.

A-378

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N. Y. • CANADA: COMBUSTION ENGINEERING CORPORATION LTD., MONTREAL

ENGINEERING

PUT THIS PYROMASTER ON YOUR NEXT TEMPERATURE CONTROL JOBS!



NEW, SIMPLIFIED operating mechanism. No motion except when temperature fluctuates. No lubrication needed.

ROUND CHART. Direct ink marking.

AUTOMATIC "AMPLISET" FEATURE. Instrument sensitivity quickly changed to suit application lag.

SIMPLE, BASIC, FREE VANE PRINCIPLE. The simple air-operated control mechanism functions *without absorbing power from the measuring system.*

HIGH ACCURACY. Easy to check. Unaffected by vibration.

LOW MAINTENANCE. Ask for Bulletin 489U.

THE BRISTOL COMPANY · WATERBURY · CONNECTICUT · BRANCH OFFICES IN PRINCIPAL CITIES

BRISTOL'S
PYROMASTER
Round Chart POTENTIOMETER CONTROLLER Direct Ink Marking

PERMUTIT ANNOUNCES

ZEO-KARB H

REVOLUTIONARY NEW FEEDWATER TREATMENT

HYDROGEN
ZEOLITE

BY ION EXCHANGE ALONE

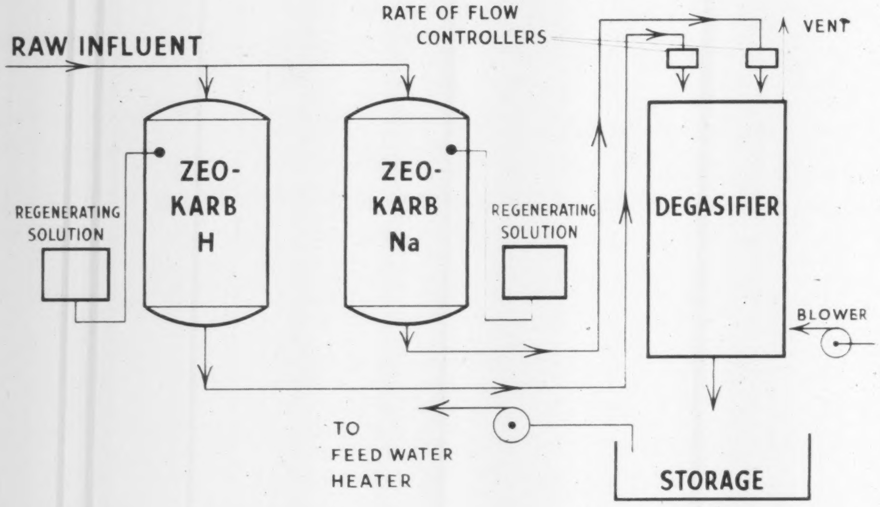
. . . . REDUCES TOTAL SOLIDS
. . . . . REDUCES ALKALINITY

READ DETAILS ON NEXT PAGE

HOW ZEO-KARB H

REDUCES TOTAL SOLIDS
CONTROLS ALKALINITY

Latest member of the Permutit family . . . worthy cousin to Permutit Hot Lime Soda and conventional zeolites is Zeo-Karb H, the new Permutit Zeolite that improves upon both hot lime soda and the heretofore available zeolites. It is made from carbonaceous material and is *non-siliceous* . . . the first zeolite to possess this characteristic.



TYPICAL ARRANGEMENT OF ZEO-KARB H & Na UNITS

Zeo-Karb H marks a revolutionary advance in the art of boiler feedwater treatment. It can be used with water of any hardness, and offers the important advantages of (1) removing scale-forming hardness while (2) simultaneously reducing total solids, and (3) reducing and controlling alkalinity to obtain ideal conditions for maintaining desired sulphate: carbonate ratios, all in positive fashion.

Zeo-Karb H is a hydrogen zeolite. By ion exchange, it gives up its hydrogen for calcium, magnesium and sodium in the raw water. Therefore, all bicarbonates in the raw water are converted to CO_2 which is mechanically scrubbed out by a simple degasifier. At the same time, chlorides and sulphates are converted to sodium chloride and sodium sulphate by blending with water which has passed through a sodium zeolite softener.

This new zeolite may also be operated through the sodium zeolite cycle, under which conditions it is called Zeo-Karb Na. It is very resistant to low pH and functions well on low hardness waters.

Thus, with a twin hydrogen and sodium Zeo-Karb unit installation, a blended effluent can be produced *by ion exchange alone* to yield boiler feedwater of low total solids and low alkalinity.

Write for complete information regarding this revolutionary new Permutit feedwater treatment! No obligation.

SEND FOR THE NEW ZEO-KARB BULLETIN

THE PERMUTIT COMPANY
330 West 42nd Street, New York City

Bulletin sent free on request.

Name ....
Company ....
Title ....
Address ....
City .... State ....

Permutit
Water Conditioning

INCLUDES ALL METHODS · PROTECTS THE BOI

TIRED WHEN ITS HOT !

Choosing Materials for Edward Valves—No. 5 of a Series

Here, in Edward physical laboratory, properties of steel are found with microscopic accuracy. From right to left: Vickers hardness testing machine. Then, Amsler tensile testing machine, consisting of: oil pump, pendulum dynamometer, testing machine itself, "pulsator" for "tiredness" tests at fluctuating loads under service temperatures, and Amsler-Martens extensometer (on tripod) for ultra-precision elongation measurement.

STEEL gets tired when it's hot. And we don't mean weather. It is the heat of operation—steam, oil, or what have you—that causes some steels to weaken faster than others. Steel stands up well, or not so well, in proportion to inherent qualities which are isolated, identified, and appraised by Edward technicians.

Edward valves are now being sold in far greater number than ever before—and Edward has always specialized in valves for severe service—for use under top heat and pressure. So Edward, more than ever, strives to use only materials that are exactly right.

Equipment in the Edward laboratories continues to stress the significance of tests over the entire temperature range at which the valves are to work.

Have you Edward material specifications guide No. A-10? It's yours for the asking.

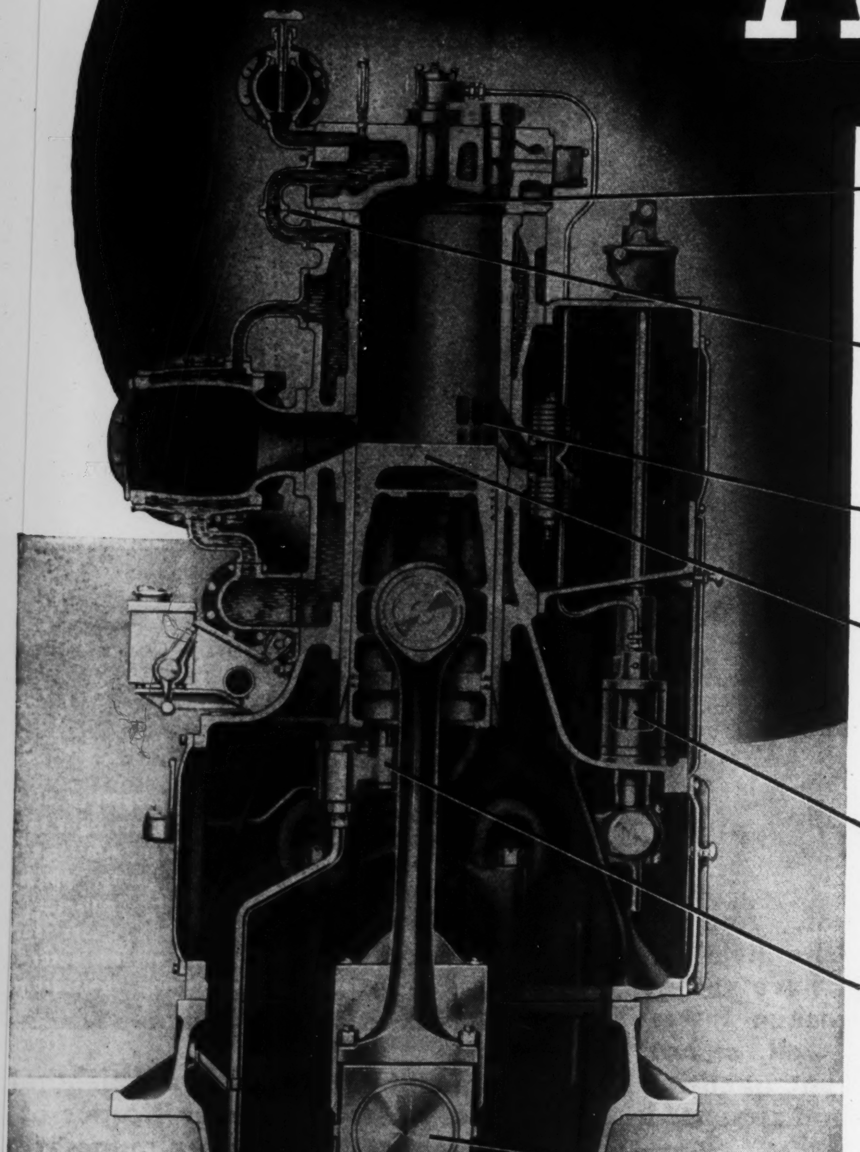
• • •

THE EDWARD VALVE & MFG. CO., INC.
EAST CHICAGO INDIANA

Edward Valves

Stop • Check • Non-return • Blow-off • Feed Line • Relief • Bleeder Line • etc

ALCO



❶ Cylinder Head of simplest possible shape, eliminating possibility of cracks from uneven expansion.

❷ Outside Water Connection, eliminating all leaks to combustion chamber.

❸ Double row of Ports, providing full cylinder charge of clean air.

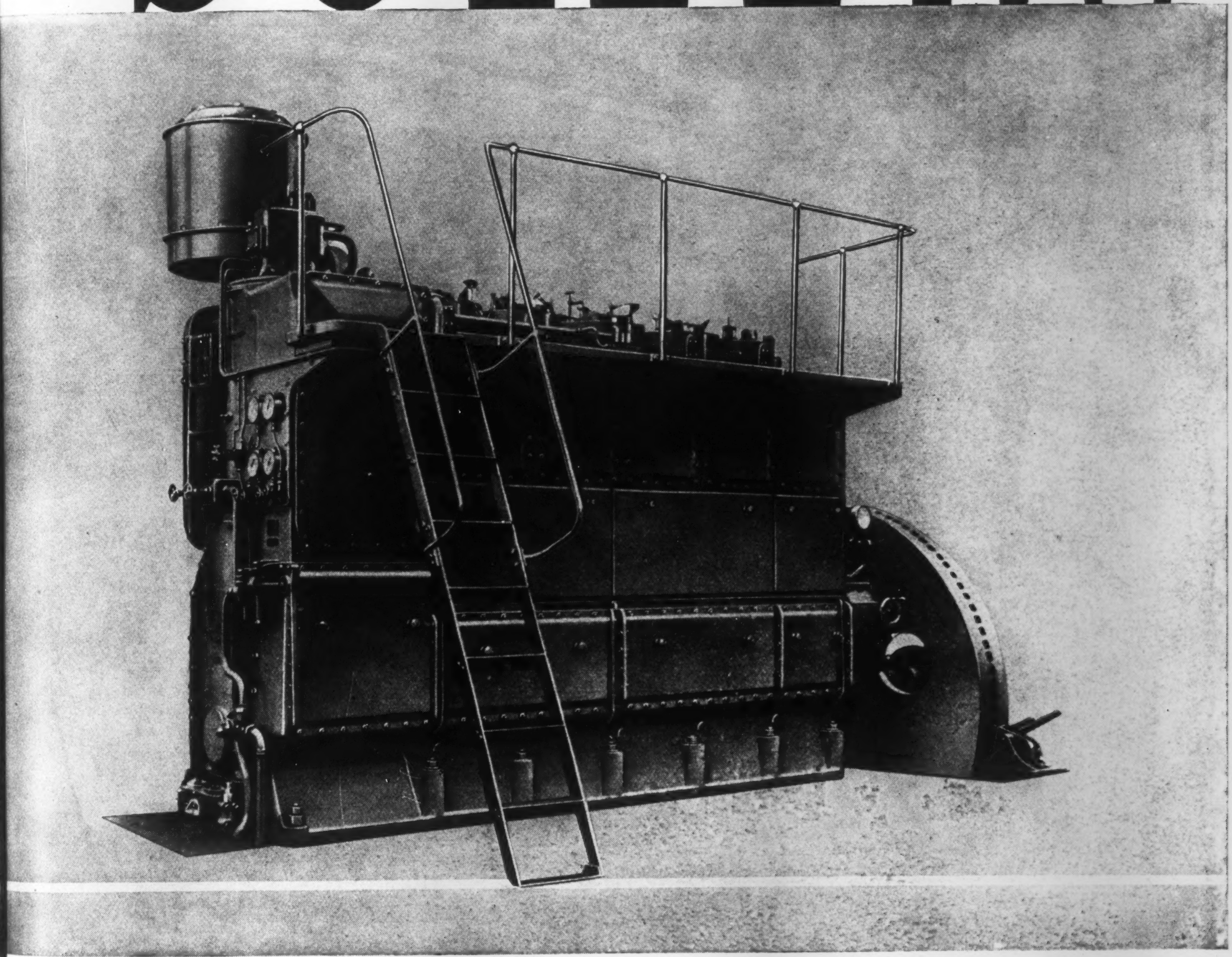
❹ Perfectly flat and smooth Piston Crown, guaranteeing long life of metal and smallest heat losses through piston.

❺ Alco-Sulzer Fuel Pumps readily accessible during operation of engine.

❻ Rugged Telescope Pipe for Piston Cooling, insuring dependable cooling of piston crown under all conditions.

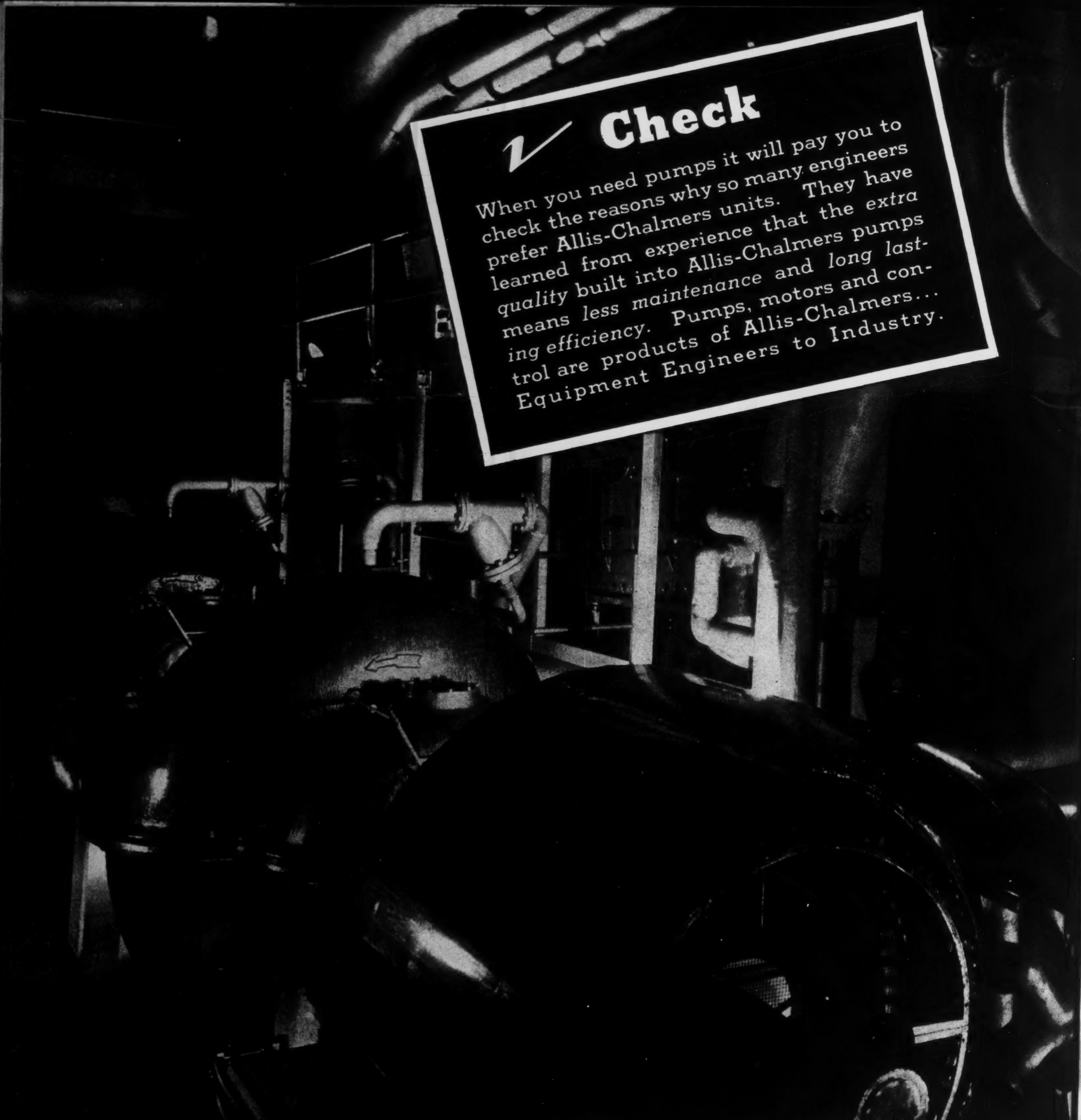
❼ Crank Pin and Main Bearing Shells interchangeable and amply dimensioned.

-SULZER..



Alco
DIESEL
ENGINE
DIVISION

AMERICAN LOCOMOTIVE COMPANY
30 CHURCH STREET, NEW YORK CITY



✓ Check

When you need pumps it will pay you to check the reasons why so many engineers prefer Allis-Chalmers units. They have learned from experience that the *extra quality* built into Allis-Chalmers pumps means *less maintenance* and *long lasting efficiency*. Pumps, motors and control are products of Allis-Chalmers... Equipment Engineers to Industry.

When you need pumps from 30 to 50,000 gpm or more

EQUIPMENT ENGINEERS TO INDUSTRY

ALLIS-CHALMERS

MILWAUKEE WISCONSIN

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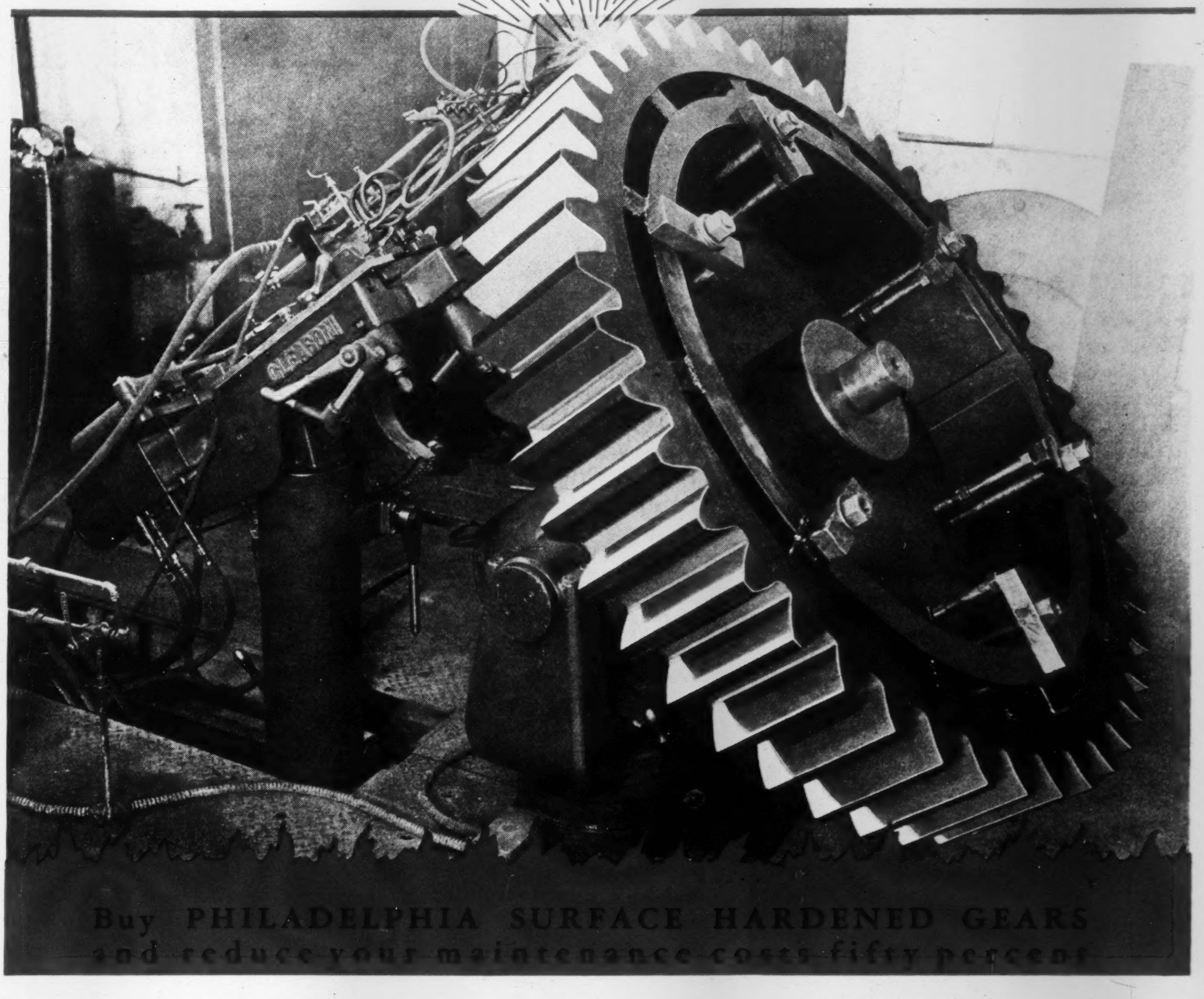
Good Gears are Better Gears

SURFACE HARDENED



Buy PHILADELPHIA SURFACE HARDENED GEARS and reduce your maintenance costs fifty percent

Phillie Gear offers a modern method for surface hardening of Gear Teeth. This process opens the field for accurate, uniform surface hardening of various types of Gears, utilizing an Oxy-Acetylene flame.

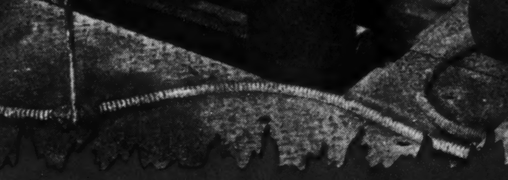
No measurable distortion can be found in surface hardened Gears . . . tooth bearings have been repeatedly checked before and after surface hardening and show no change. Neither is the body of the Gear changed during the process. This freedom from distortion is an important advantage in many ways, since absolutely uniform bearing on all teeth is most desirable from a wear standpoint.

Another important advantage with our equipment is the simultaneous hardening of both sides of a tooth at one time.

A wearing surface equal to case hardening can be obtained —Rockwell 55/60—Scleroscope—65/70. Penetration can be varied to any desired amount dependent upon the pitch of the Gear. Gears up to 100-inch diameter of the Spur, Helical, Bevel, Spiral Bevel and Herringbone types can be hardened with our equipment.

Details cheerfully furnished. Write—

PHILADELPHIA *Gear Service*

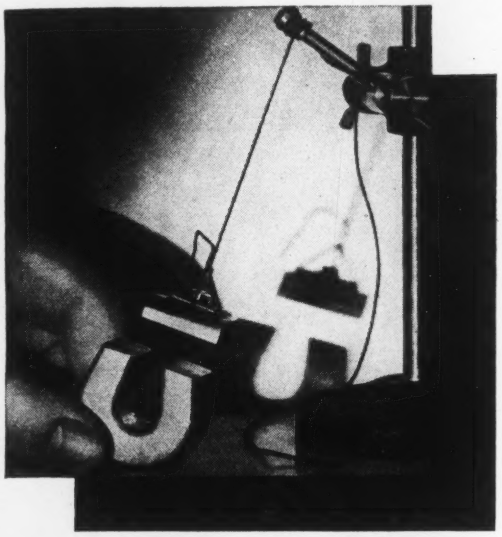


PHILADELPHIA GEAR WORKS
Industrial Gears and Speed Reducers
ERIE AVENUE AND G STREET, PHILADELPHIA, PA.

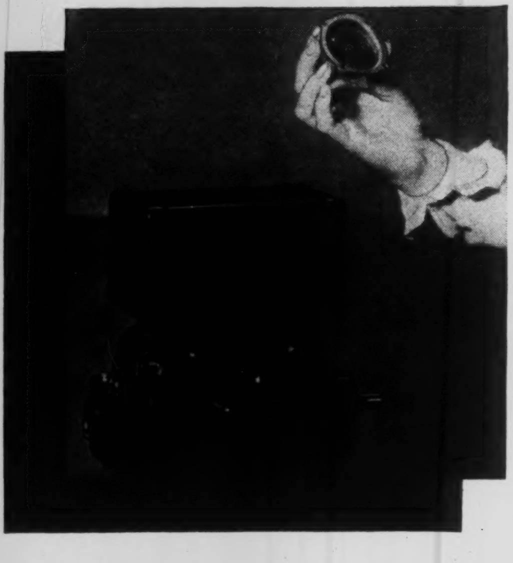
HIGH NICKEL ALLOYS

RAISE EFFICIENCY AND LOWER COSTS

...in scores of special applications



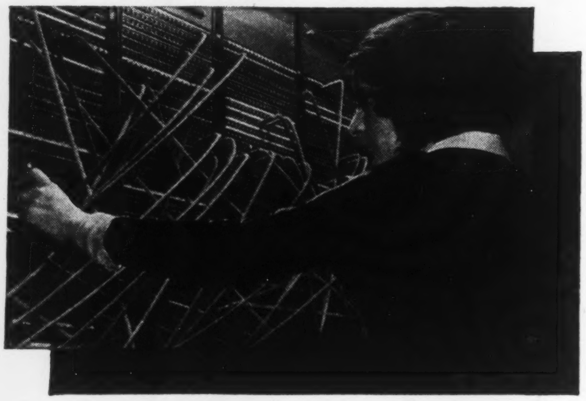
HIGH MAGNETIC QUALITIES... The magnet pictured here is small, but extraordinarily powerful—capable of lifting 60 times its own weight. This particular type, made of a new alloy rich in Nickel, is used for damping magnets in the polyphase meters of the Duncan Electric Co., Lafayette, Ind. Not only do these alloys of high Nickel content effect substantial savings in weight (in this case 80%) but they also have a higher permanency factor than other commercially available magnetic materials and are practically immune to the effects of magnetic disturbances caused by short circuits and lightning. Manufacturers who employ magnetic materials in their products will find these new alloys of Nickel profitable to investigate.



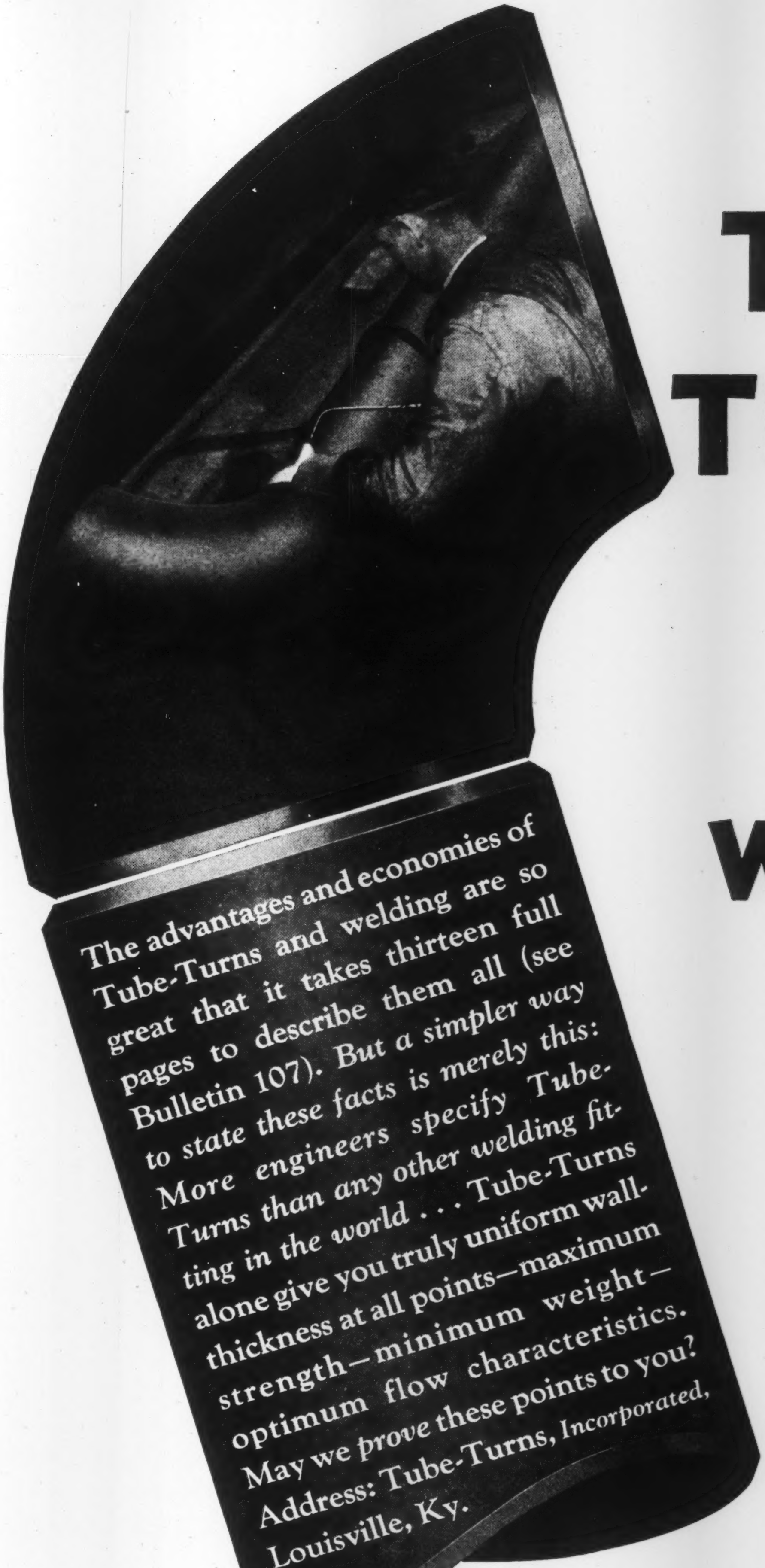
HIGH AND LOW EXPANSION PROPERTIES...

One of the most valuable metallurgical developments in recent years has been the production of thermostatic metals for operating automatic control devices. Pictured here is one employing a bi-metallic disc made of two alloys of Nickel, one having a high degree of expansion and the other low expansion properties. It guards the Westinghouse refrigerator motor, disconnecting it when it gets too hot and reconnecting it when it cools off. Principle upon which these thermostatic metals operate is based on a differential in the expansion properties of the two constituent metals. Changes in temperature cause them to deflect and this in turn acts on the control device. Alloys of Nickel can be produced for applications requiring extremely low expansions as well as for service where specific expansion characteristics may or may not be low.

IMPROVED PERMEABILITY... When you make your long distance telephone call or send a cable, a highly magnetic Nickel-Iron alloy of improved permeability containing up to 80% Nickel helps to deliver your message. Impulses sent over long circuits have a tendency to drag their "tails" behind them, upon which succeeding impulses tread. But through the use of loading coils made of a high Nickel alloy, and spaced at regular intervals along the circuit, transmission is speeded up and your words made intelligible. The high magnetic permeability of these alloys is also depended upon to increase the efficiency of submarine cables and various parts of radio, telephonic and telegraphic installations. We invite consultation on the use of the Nickel alloys in your equipment.



THE INTERNATIONAL NICKEL COMPANY, INC., NEW YORK, N.Y.



TUBE-TURNS* LEAD THE WORLD!

The advantages and economies of Tube-Turns and welding are so great that it takes thirteen full pages to describe them all (see Bulletin 107). But *a simpler way to state these facts is merely this: More engineers specify Tube-Turns than any other welding fitting in the world* . . . Tube-Turns alone give you truly uniform wall-thickness at all points—maximum strength—minimum weight—optimum flow characteristics. May we *prove* these points to you? Address: Tube-Turns, *Incorporated,* Louisville, Ky.

*The word "Tube-Turn" is NOT a necessary general trade name for welding fittings. It is the registered trade-mark for the products made by Tube-Turns, Incorporated, under their patents.

IF THE *PROFITS* ARE
your CONCERN
—send for this BOOK
It's FREE *to Executives*

LEIPZIG TRADE FAIRS
THE GREAT ENGINEERING
AND BUILDING FAIR

Every important industrial executive should have a copy of this new book. It describes and pictures, in considerable detail, the world's largest, international engineering fair—2,500 exhibitors; machinery, equipment, tools and processes for every industry; 5,000 machines in actual operation; 17 gigantic halls; acres of outdoor displays. Simultaneously, the General Merchandise Fairs offer an opportunity to examine and compare the latest in both finished and semi-finished goods. A total of 8,500 exhibitors from 25 countries; drawing 250,000 executives and buyers from 72 countries.

Whether you exhibit, buy or merely investigate, the Leipzig Trade Fairs can materially contribute to your profits. Write today—on your business letterhead—for a copy of our new book, No. 53. There is no charge or obligation. Leipzig Trade Fair, Inc., 10 East 40th Street, New York.

THE GREAT ENGINEERING AND BUILDING FAIR

MARCH 6TH TO 14TH

A DIVISION OF THE 700-YEAR-OLD
LEIPZIG TRADE FAIRS

Not only *our* opinion . . . but *THEIRS!*

USERS SAY:

Invariably *cast iron* pulleys have proved to be the best investment. Comparison shows them truer-running . . stronger . . more enduring under even the most exacting service conditions. And experience shows that

WOOD'S
Cast Iron
PULLEYS

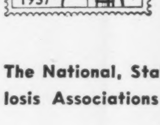
machine-moulded from finest metals and carefully machined, are more uniformly power thrifty on any drive. A sure bet for a "smoother run for your money".

Modestly we agree—by going back to our original premise that Cast Iron pulleys are far superior. That has always been our contention . . . and it is borne out by the FACTS. Facts, incidentally, which are freely yours to examine if you'll write—

T. B. WOOD'S SONS CO.
CHAMBERSBURG, PA.
0 Church St., New York City 387-391 Atlantic Ave., Boston
MEMBER: The Mechanical Power Engineering Associates

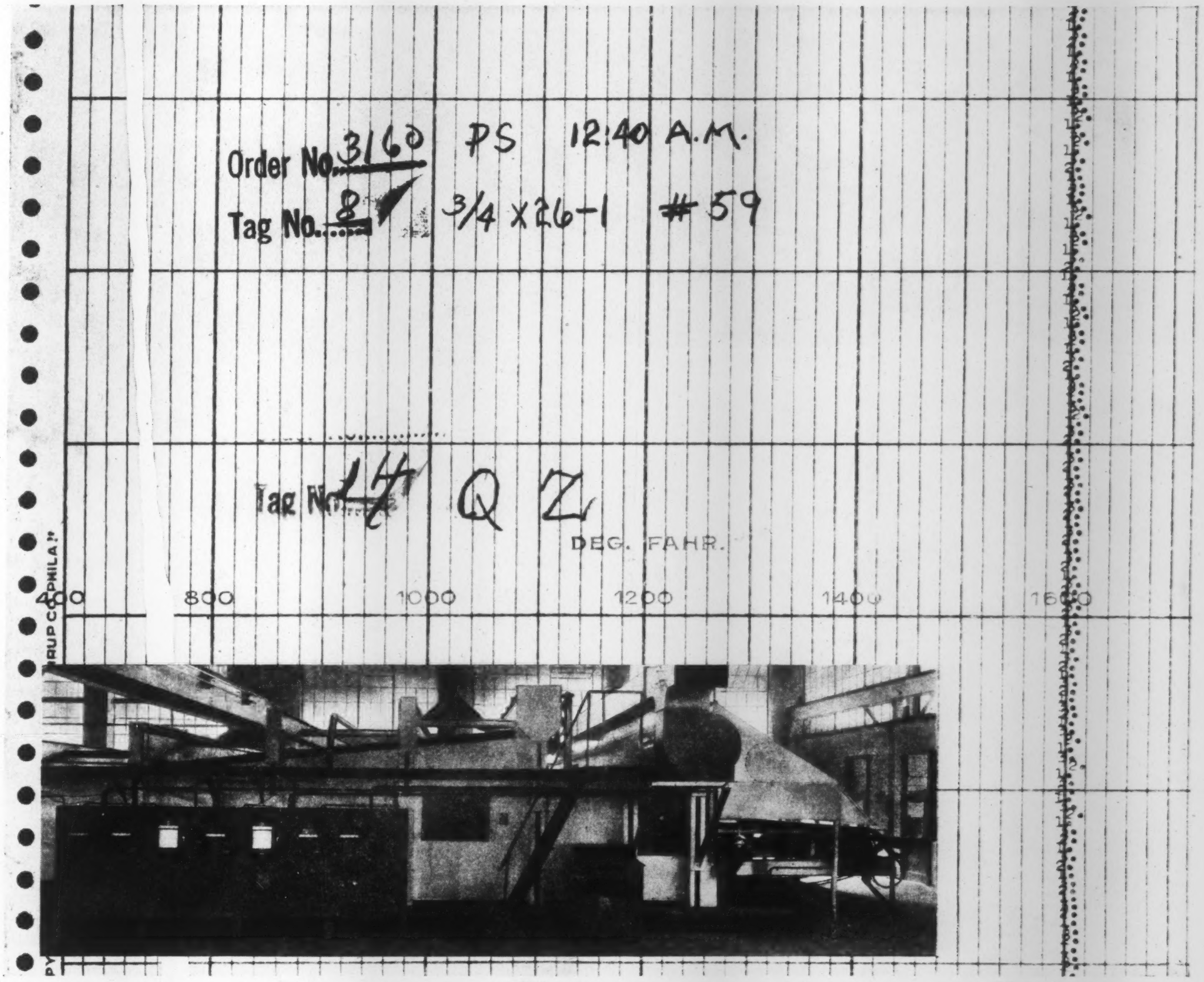
RINGING IN HEALTH

The 1937 Christmas Seals



BUY and USE them

The National, State, and Local Tuberculosis Associations in the United States



IN BIG FURNACES LIKE *This* . . GET UNIFORMITY LIKE *This* . . WITH

MICROMAX ELECTRIC CONTROL

Here's a 64-burner gas-fired furnace, more than forty feet square *inside*—for continuous normalizing of "sucker rods." Yet, big as it is, it's so precisely regulated by Micromax Electric Controls that couples located at points of greatest temperature departure always stay within ± 10 degrees, and generally within half that limit. Its owner, the Axelson Mfg. Co., St. Louis, reports "no difficulty whatever" in holding these temperature limits.

For all its effectiveness, Micromax Electric Control is so simple, so sensitive and so correct in operating principle, that one of the identical Micromax Pyrometer and Drive Unit combinations on this furnace could be used "as is"—without the removal or addition of a single part—on a tiny oven furnace, a pot furnace, still or practically any other heat-using equipment. You can standardize on Micromax Electric Control for every furnace. You can have big-furnace dependability of control for the small units; small-furnace simplicity for the big ones.

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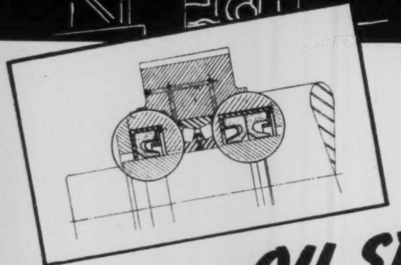
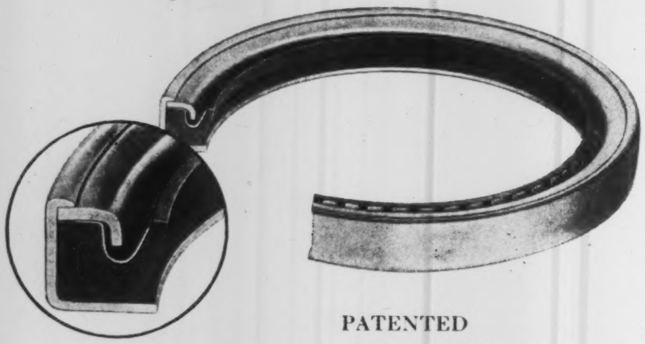
J-NA(7)

GRIT!
SAND!
WATER!



Left: Application of Garlock KLOZURES to Steel Mill Back-Up and Work Rolls.

Here's an OIL SEAL that Stands It!



PATENTED

GRIT . . . sand . . . mill scale . . . water . . . heat . . . grease and oil—that's what an oil seal encounters on Roll Neck bearings in the steel mills. What grueling service! Yet, Garlock KLOZURES *stand up* under these severe conditions and give efficient, uniform performance day in and day out. In hundreds of other industries, too, these superior Oil Seals are establishing remarkable performance records. The sealing element is dense, grainless, tough, resilient—resists dirt, oil, heat and wear. Complete range of sizes. Write for catalog!

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Smooth Meshing
Gears

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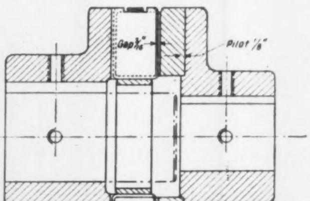

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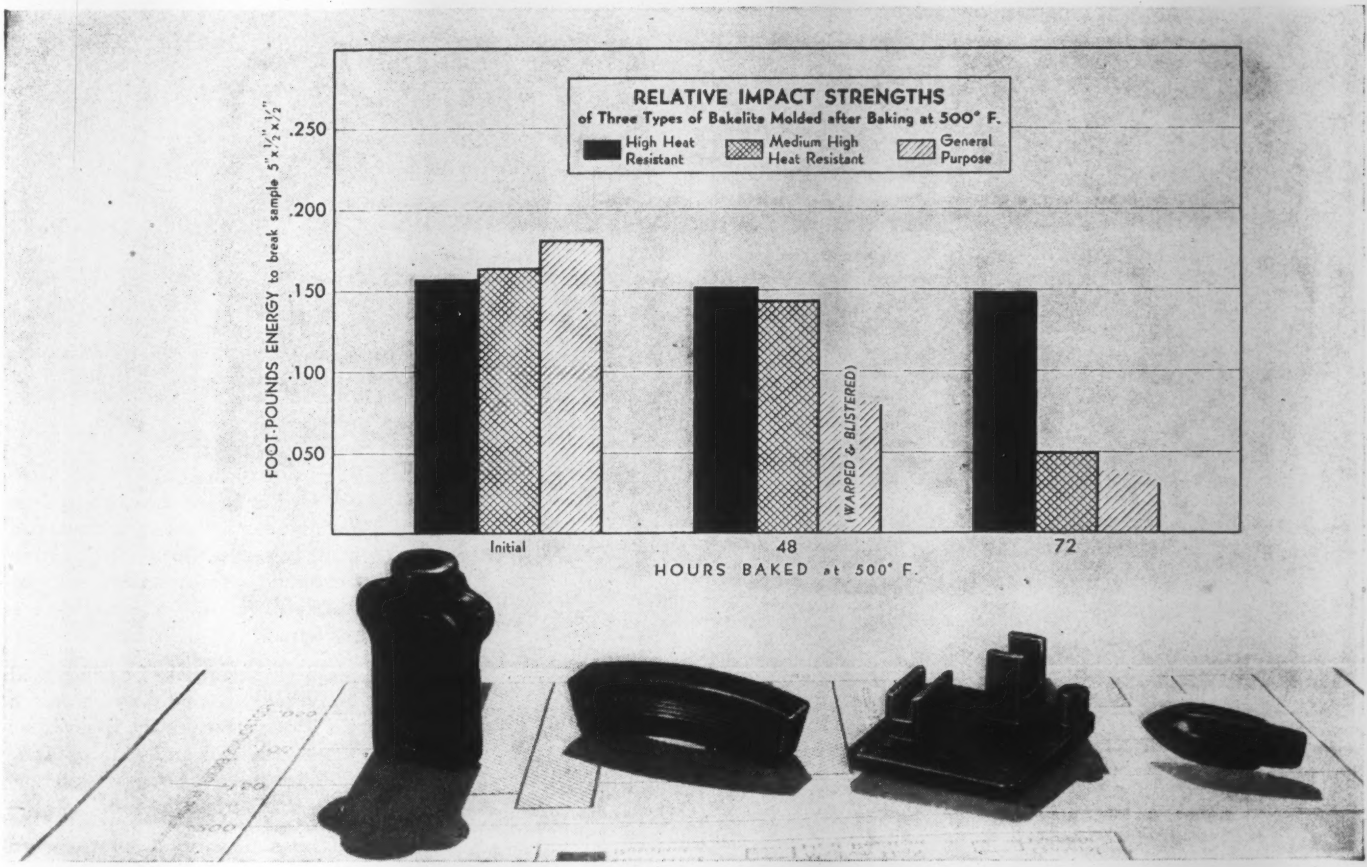

Heater plug, ovenware handle, switch base and electric iron control knob of High Heat Resistant Bakelite Molded. Chart shows effects of baking at 500°F. on three types of Bakelite Molded.

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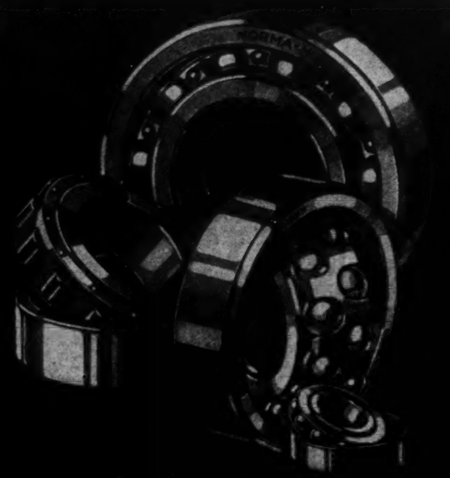

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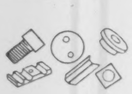

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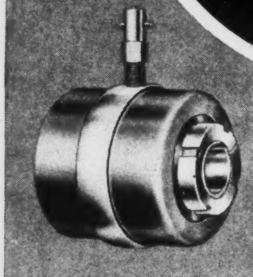

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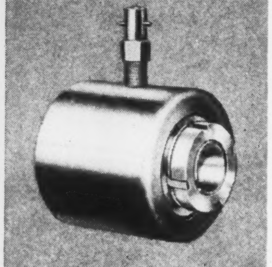

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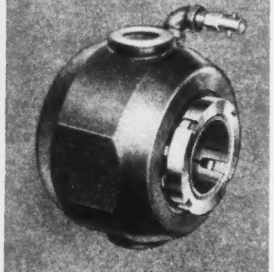

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JONES roller bearing pillow blocks and bearing units are built to solve those tough drive problems where stamina and the ability to "take it" are mighty important.

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This "Buffalo" Limit-Load Conoidal Fan with Silent Floating Base is but one of many types and sizes manufactured by Buffalo Forge Company, fan specialists for nearly 60 years.

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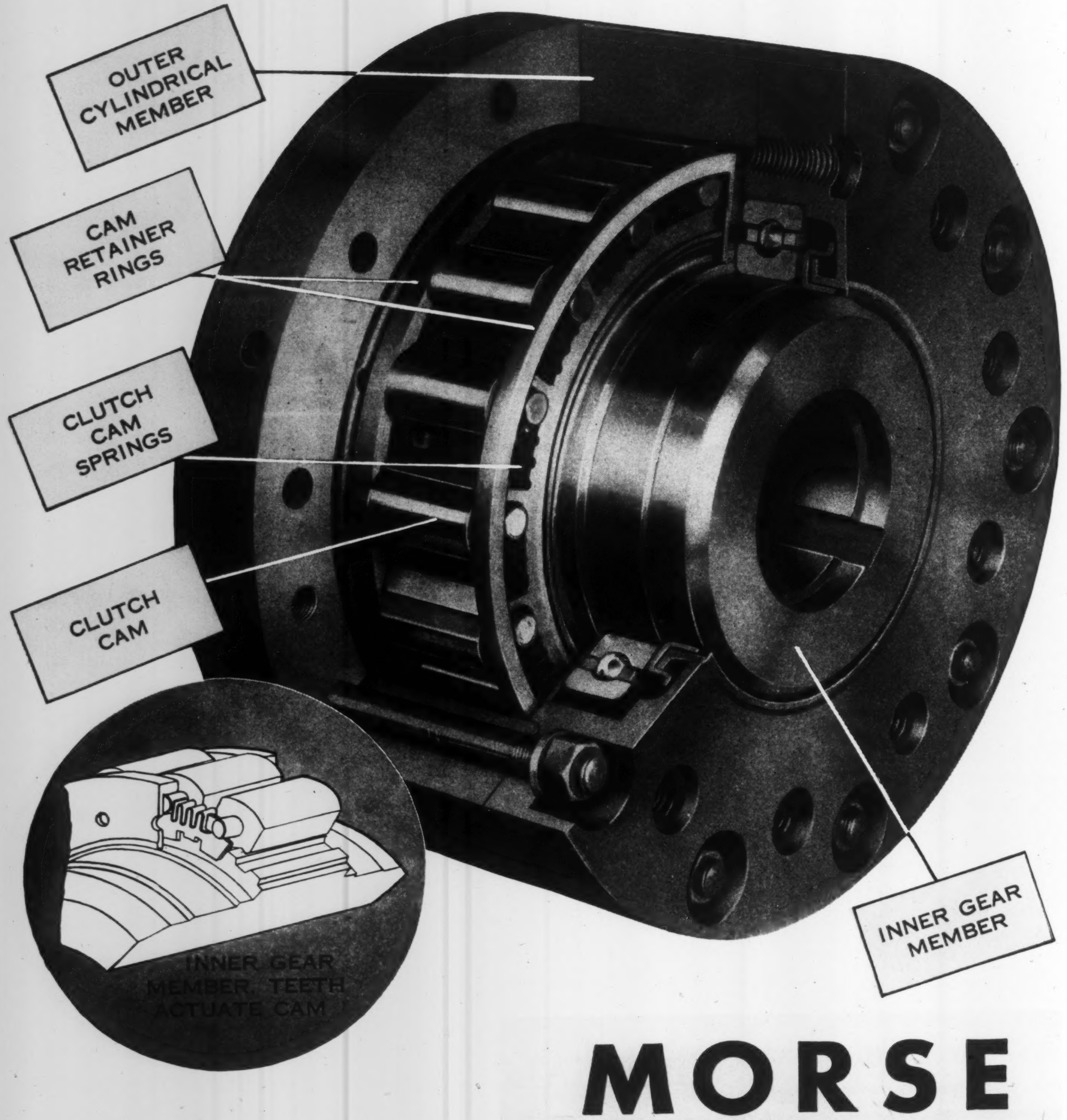
Buffalo, New York

Kelpo FREE WHEELING CLUTCHES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MORSE

MORSE CHAIN COMPANY

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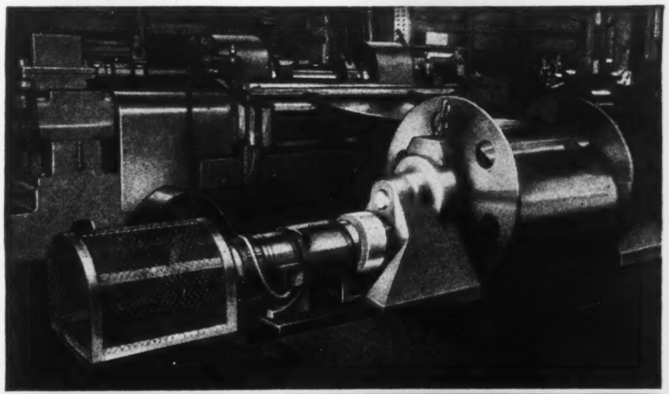
In many power applications, stand-by prime movers are frequently necessary. Morse positive free-wheeling clutches make this possible, greatly simplifying installation and improving the economy of operation.

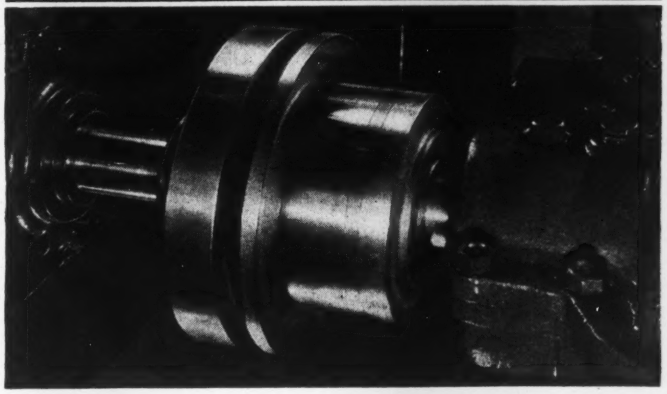
The frictional resistance of free-wheeling a Morse Kelpo is from 4% to 9% less than power loss in turning a dead prime mover. Power savings alone will pay for this clutch! It free wheels as easily as a ball bearing spins, yet it is as positive as a gear.

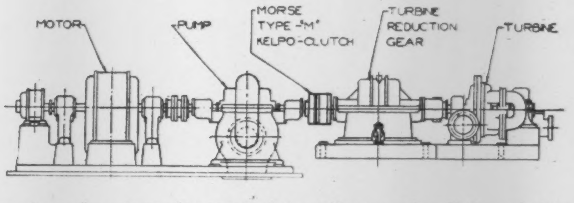
The engineering and construction of Morse Kelpo is such that it can free-wheel continuously month after month, or engage and disengage with as much regularity as is necessary in the job to be done.

High grade alloy steels are used in driving gears, cams and rings. Careful heat treating is utilized to prevent Brinelling of contact surfaces. Ball bearing members in each clutch separate driving gear and ring members, allowing the cams to float independently. Special cam retainers protect the cams from the effects of centrifugal force. Free wheeling resistance is at absolute minimum.

The services of Morse engineers are cheerfully offered in working out special applications. Call in your nearest Morse representative, or write direct to Morse, Ithaca.







Above is a drawing of a typical installation of a Kelpo clutch on a dual power drive. Either power source may be operated independently of the other, with clutch free-wheeling and the idle driver at rest.

FREE WHEELING & INDEXING CLUTCHES

The Morse High Torque Indexing and Free Wheeling Clutch fills a definite need for an inexpensive, dependable clutch in many types of machine operations. It is particularly adapted to indexing and ratchet feed mechanisms in the machine tool field. It is sturdily built and positive in action. Grip and release are actuated by leaf springs in contact with the shouldered ends of the cams.

Positive DRIVES

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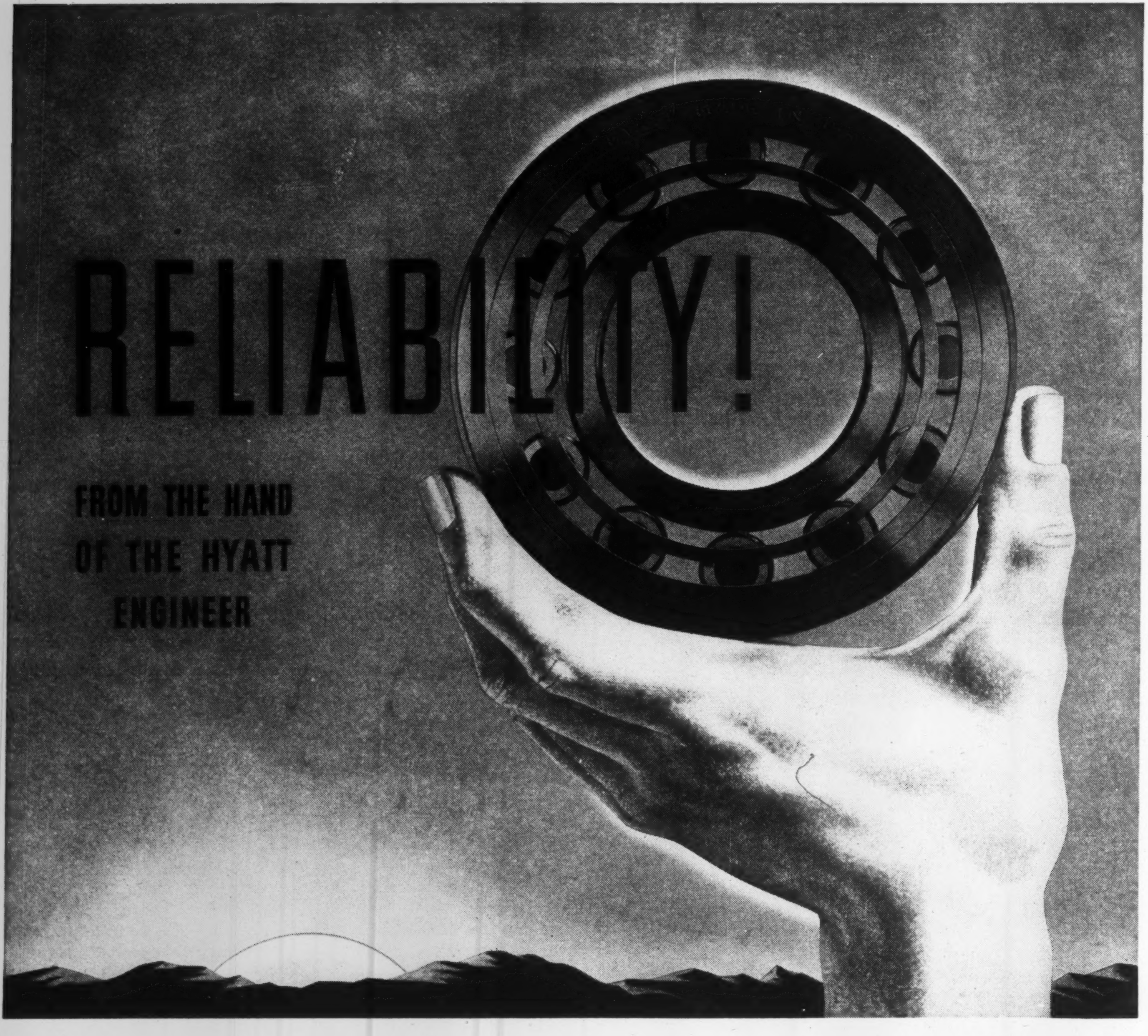
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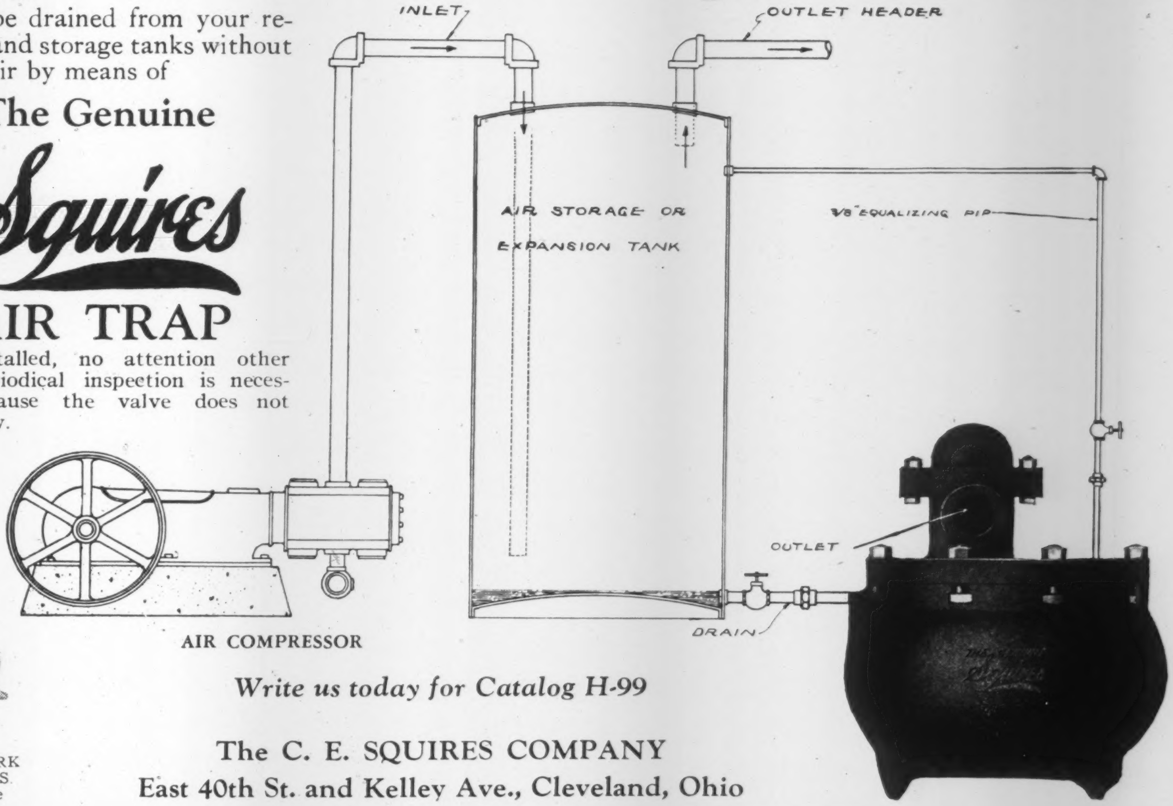

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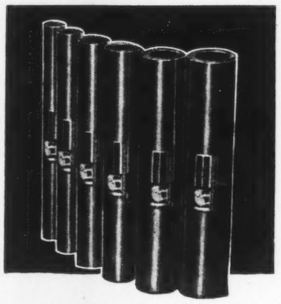

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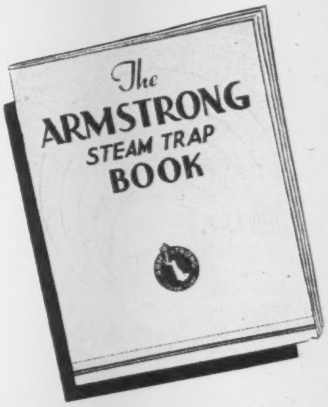

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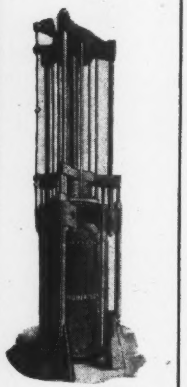

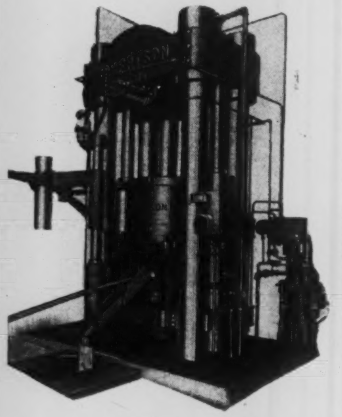

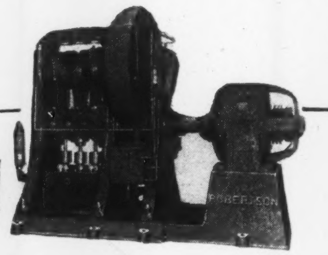

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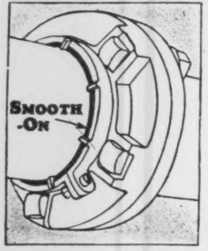

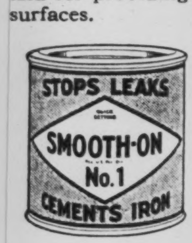

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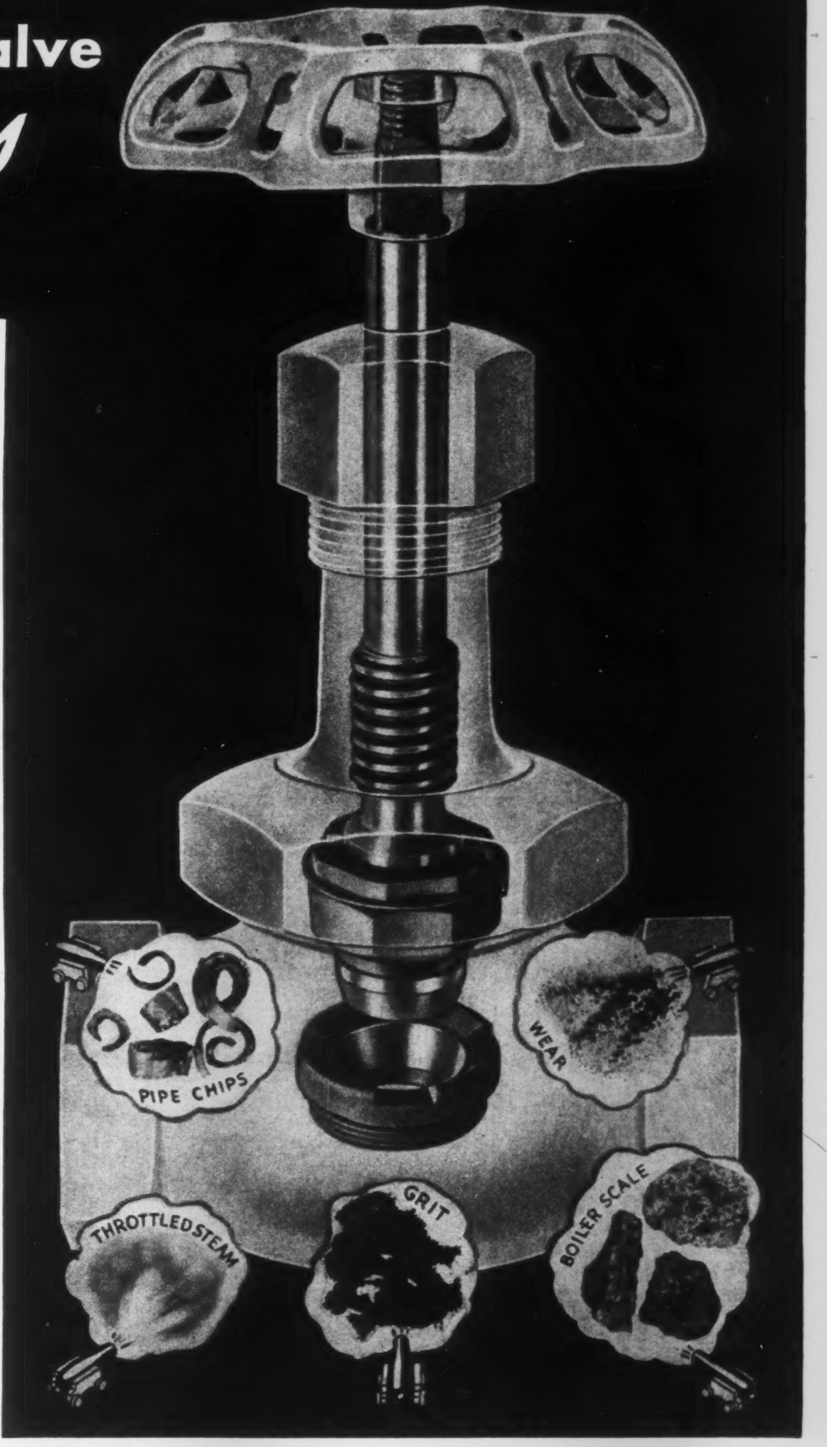
LET JENKINS 'ARMOR-SEAT' save you from Valve *Destroyers*



New PLUG SEAT that EXCEEDS 500 BRINELL hardness makes this Jenkins Fig. 976 Valve practically impervious to wear . . . cutting . . . wire drawing!

HERE is definite protection against valve destroyers . . . a plug seat developed by Jenkins after long effort to secure the most effective combination of design and metal for extremely severe services.

MADE OF JENKINS JX500, a superior stainless steel having a Brinell hardness in excess of 500, this Plug Seat is practically impervious to wear, wire-drawing and other valve enemies. It cannot be cut by throttled steam or harmed by substances which commonly get into pipe lines, such as pipe chips, welding beads and rust tubercles.

This new "Armor Seat", with the extra quality which Jenkins provides throughout, makes Jenkins Fig. 976 Bronze Valve as nearly wear-proof, maintenance-proof and trouble-proof as a stock valve can be made. It will reduce maintenance and replacement expense on any exceptionally hard duty lines in your plant . . . such as continuous throttling for pressure reduction, free-blow service like soot blowers, injectors, heating coils, or close regulation of steam. Write us or ask your supply house for details and prices on globe and angle patterns for 300 lbs. W. S. P., or 600 lbs. O. W. G.

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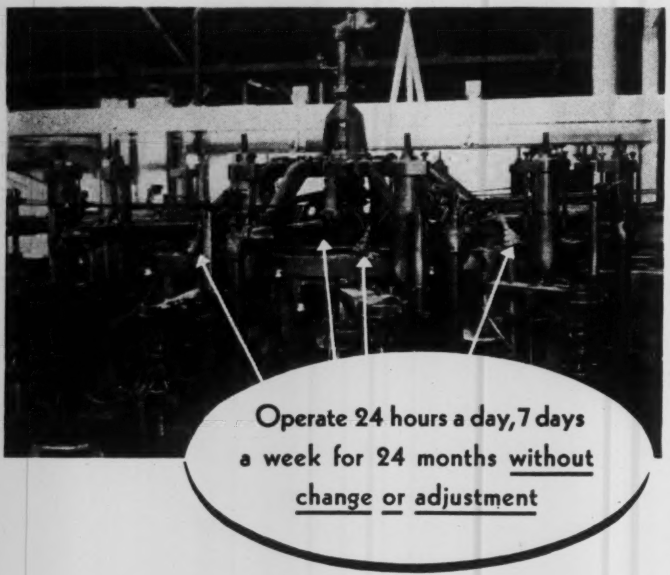
PERFORMANCE RECORDS

Prove Exceptional Stamina and Economy of BARCO Joints . .


Operate 24 hours a day, 7 days a week for 24 months without change or adjustment

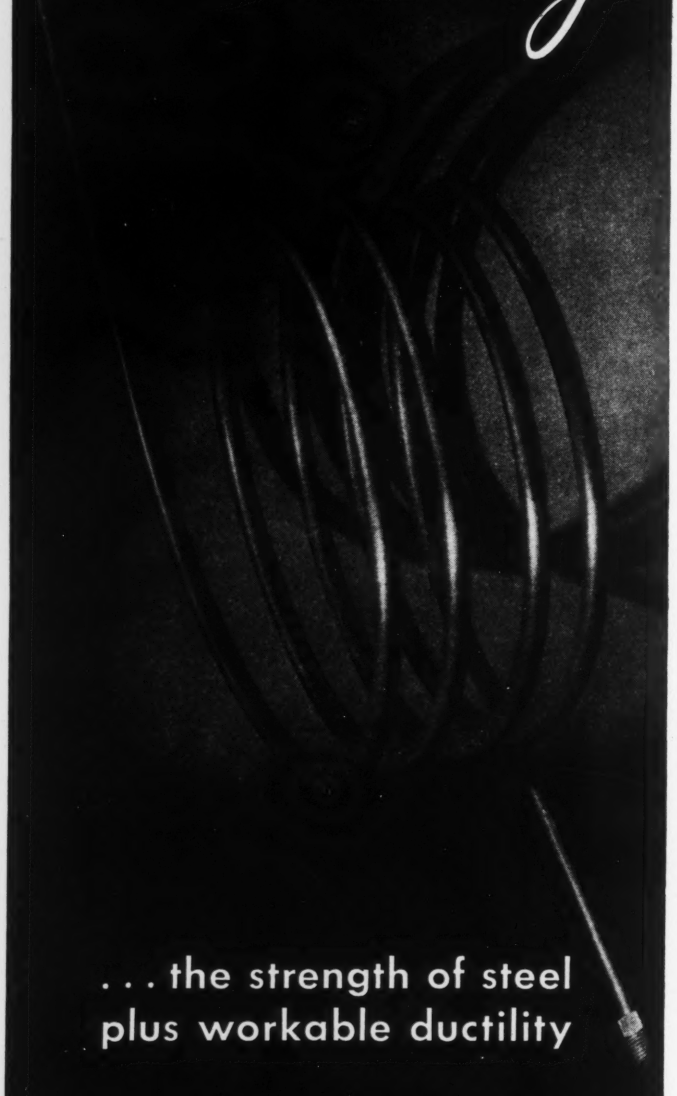
● Vital operations of this bottle manufacturing machine are safe-guarded . . . at amazingly low cost . . . by BARCO Joints—Pipes carrying vacuum at atmospheric pressure, and air lines carrying from 15 to 30 pounds pressure . . . which must adjust constantly to the dipping movement of machine heads . . . are sealed perfectly during twenty-four months of almost continuous operation. "The flexibility and leakproof performance of BARCO Joints is so effective," says The Glass Company, "that they usually require no changes or adjustments during the entire life of a furnace."

BARCO FLEXIBLE JOINTS

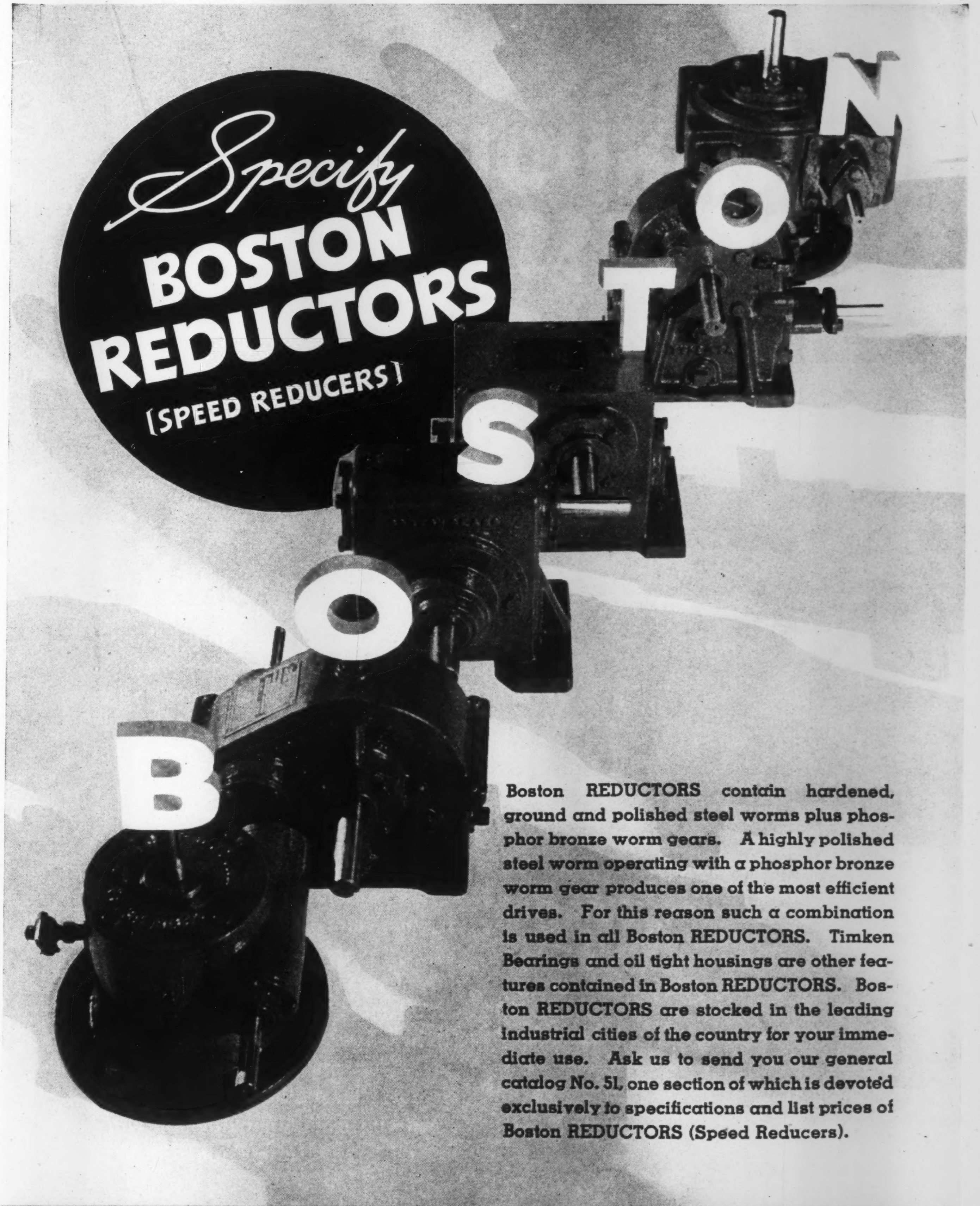
BARCO MANUFACTURING COMPANY

1811 Winnemac Ave., Chicago, Ill.

Bundy Tubing



BUNDY TUBING CO.
DETROIT



Boston REDUCTORS contain hardened, ground and polished steel worms plus phosphor bronze worm gears. A highly polished steel worm operating with a phosphor bronze worm gear produces one of the most efficient drives. For this reason such a combination is used in all Boston REDUCTORS. Timken Bearings and oil tight housings are other features contained in Boston REDUCTORS. Boston REDUCTORS are stocked in the leading industrial cities of the country for your immediate use. Ask us to send you our general catalog No. 51, one section of which is devoted exclusively to specifications and list prices of Boston REDUCTORS (Speed Reducers).

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NORTH QUINCY, MASS.

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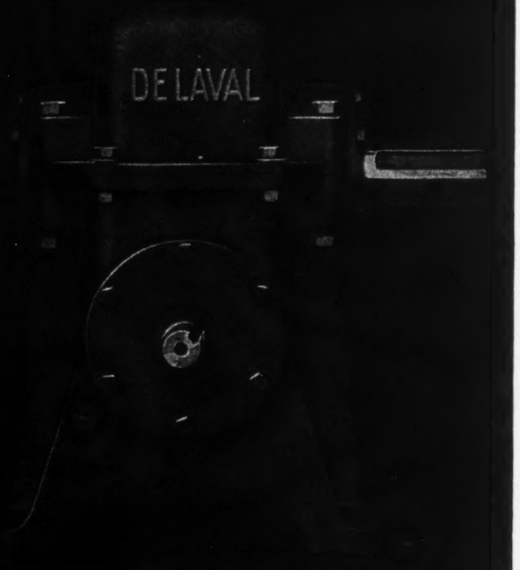


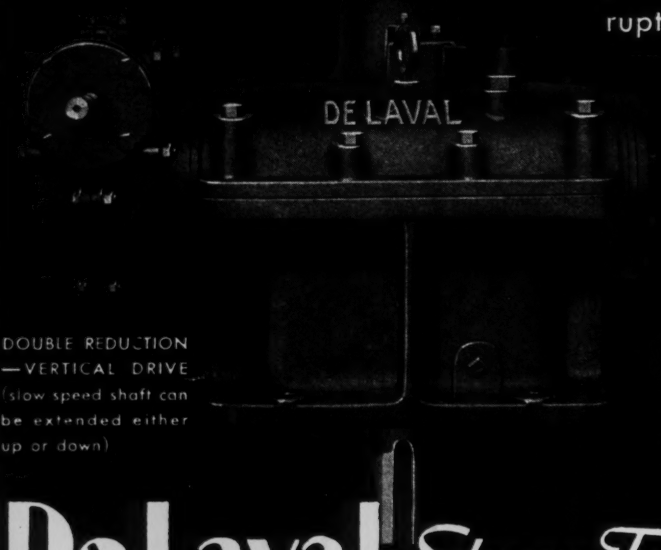
SINGLE REDUCTION—BOTTOM DRIVE

SINGLE REDUCTION—TOP DRIVE

THE 30 years devoted by the De Laval shops to the manufacture of first quality speed transformers for high speed, heavy duty service have discovered principles, and developed methods, of gear design and construction which have proved indispensable for the continuous carrying of heavy loads over long periods.

DE LAVAL WORM GEARS transmit large powers at high, or slow, speeds uninterruptedly for years, even under the most severe conditions of dust, dirt, grit and moisture.

Wherever slow or medium speed machinery is to be driven by standard speed motors or steam turbines, De Laval Gears can be applied to save power, upkeep cost and space. Our speed reducer specialists will gladly assist with engineering advice in working out your transmission problems.



DOUBLE REDUCTION —VERTICAL DRIVE (slow speed shaft can be extended either up or down)

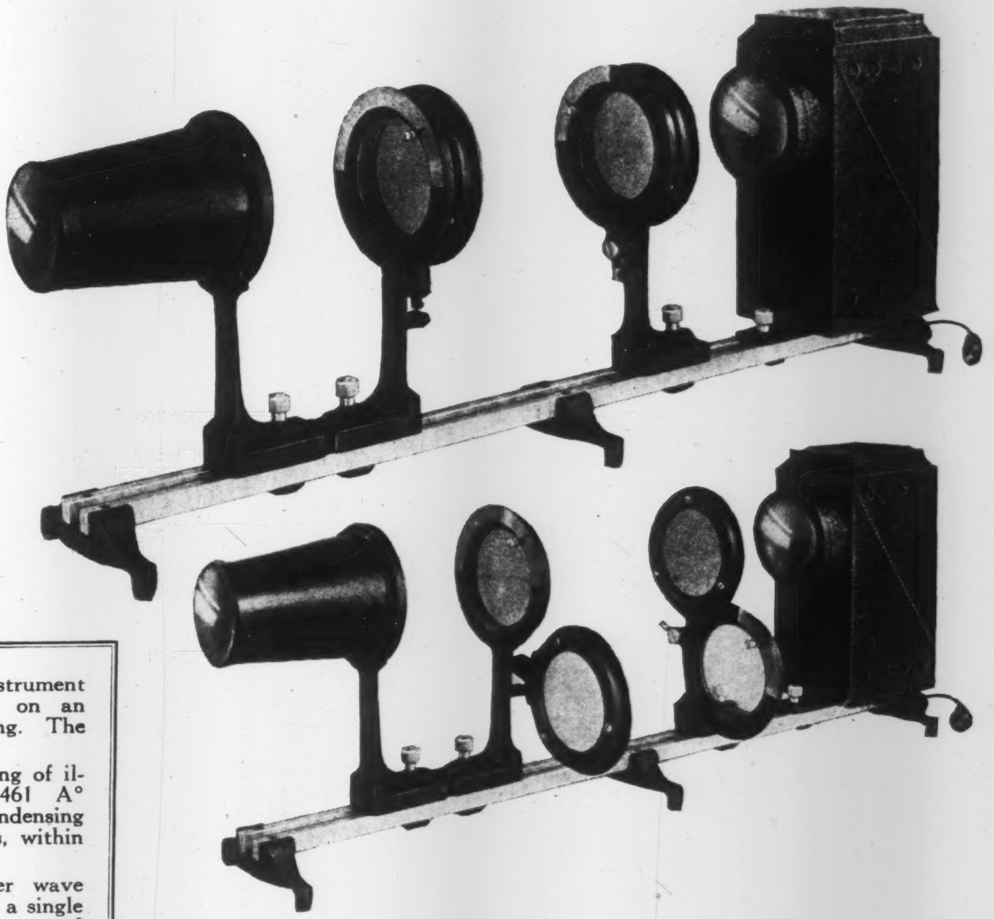
De Laval *Steam Turbine Co.,* **Trenton, N. J.**

1081

Manufacturers of Steam Turbines, Centrifugal Pumps, Propeller Pumps, Rotary Displacement Pumps, Centrifugal Blowers and Compressors, Worm Gears, Helical Speed Reducing Gears, Hydraulic Turbines, Flexible Couplings and Special Centrifugal Machinery. Sole Licensee of the Bauer-Wach Exhaust Turbine System.

Polaroid — *for Stress Determination*

with LARGE Aperture
PHOTOELASTIC POLARISCOPE



Photograph of
the apparatus
with quarter wave
plates in position

below

The quarter wave
plates are swung
out of position

The illustration shows an instrument of 4¼″ aperture mounted on an optical bench one meter long. The four units are:

- The Light Source, consisting of illuminator, filter for 5461 A° (with mercury light), condensing lens and collimating lens, within a single compact unit.
- The Polarizer and quarter wave plate mounted in unit on a single rider but calibrated and rotated independently of each other.
- The analyzer and quarter wave plate similar to polarizer.
- The Projection system.

The polarizer and analyzer are set in rotating mounts with scale reading for 180°; the quarter wave plates are in rotating mounts with scale reading for 90°.

By this unique arrangement, this new model, with its simplified construction, facilitates photoelastic investigation. For taking the isoclinics, the quarter wave plates are merely swung out of position. The four units are mounted on a bench designed primarily for photoelasticity; no part of the set-up can be pushed out of optical alignment by accidental contact with the technician.

The simplicity of the instrument is accentuated by the fact that there are no lenses in any position between the polarizer and the analyzer eliminating inaccuracies caused by strained lenses, or depolarization which occurs at the edges of lenses

The 4¼″ aperture with "white" light source is priced at $300.00

THE importance of photoelasticity for stress determination has been known for some time but in many cases, use has not been made of it because of the many objections to the Nicol prism arrangement to which one was limited prior to the development of Polaroid. In contrast to the complex apparatus heretofore used is the Polaroid-equipped photoelastic polariscope which is simple in construction, convenient for use and much lower in cost.

The change in design has been made possible only by the development of large area polarizing media and large area quarter wave plates.

Standard sizes are available in apertures of 4¼″, 6¼″ and 8¼″; special sizes can be had up to 12″ aperture. The light source may be ordinary light or mercury light (fitted with filter for 5461 A°). And for those who wish to construct their own apparatus, we will furnish any of the parts.

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"Ferrenewo"

200 lb. SP—Fig. 73-P
Bronze "Renewo"

300 lb. SP—Fig. 16-P
Bronze "Renewo"

300 lb. SP—Fig. 1690-P
Screwed Yoke
Bronze "Renewo"

150 lb. SP Fig. 1857-P
All-Iron "Ferrenewo"

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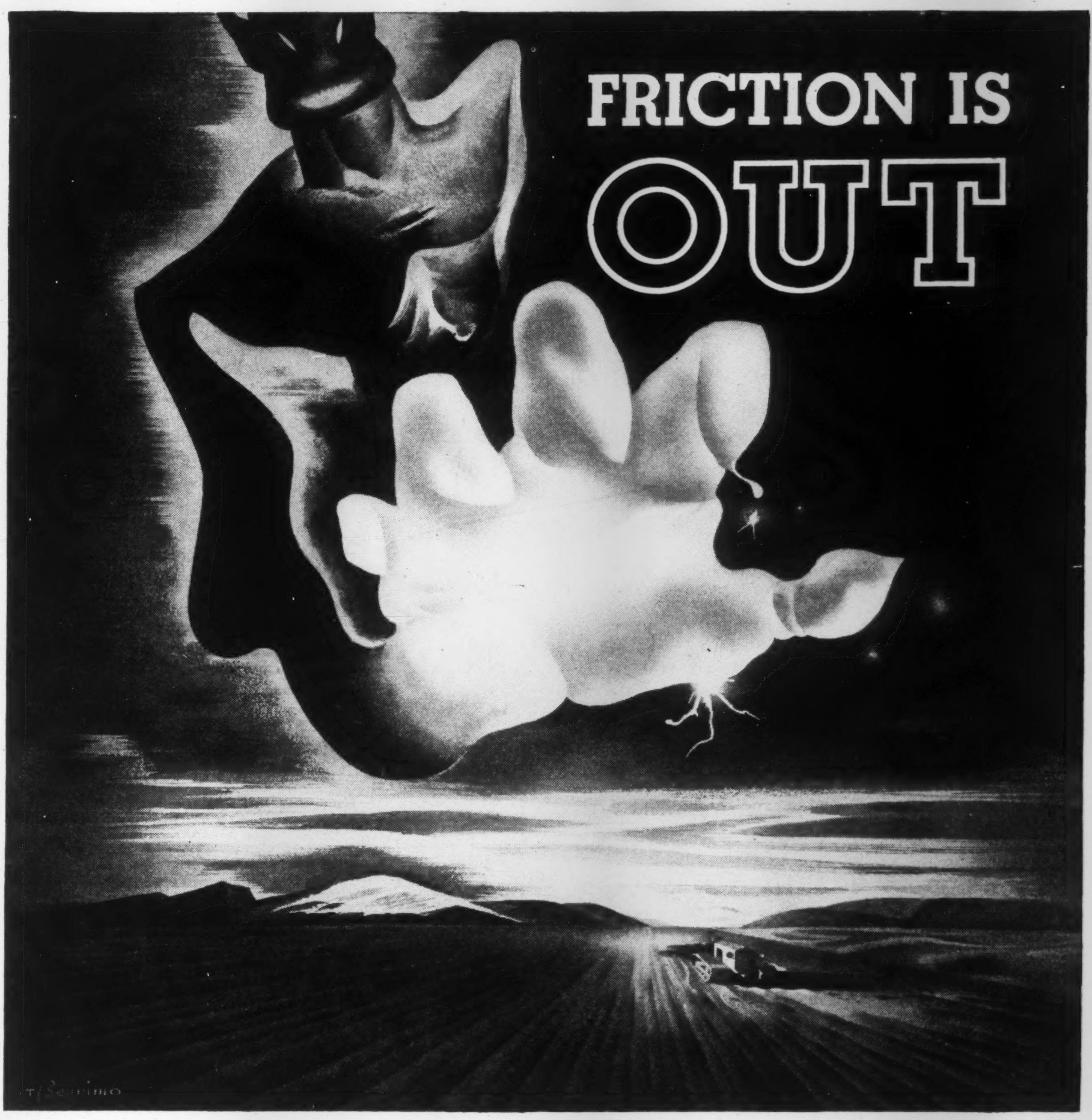
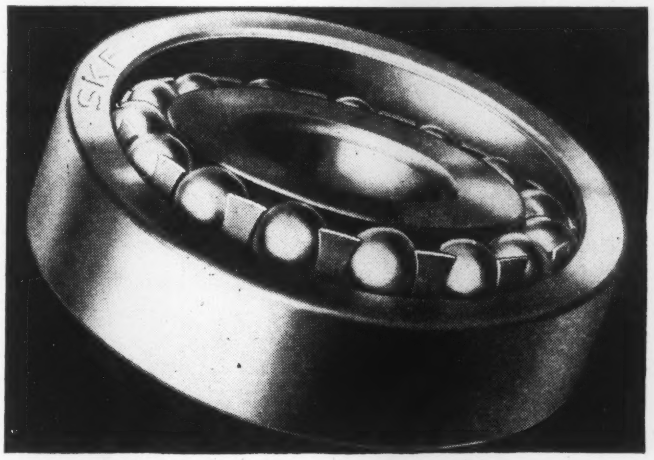


4005

MODERN FARM MACHINERY IS SKF-EQUIPPED



Friction doesn't do any summering down on the farm these days. Or wintering either for that matter. For on the most modern of mechanized farms of today, plain bearings are *out*. In their place are SKF Ball and Roller Bearings, lengthening the life of equipment, reducing upkeep costs, protecting the farmer against the hazards of untimely breakdowns.

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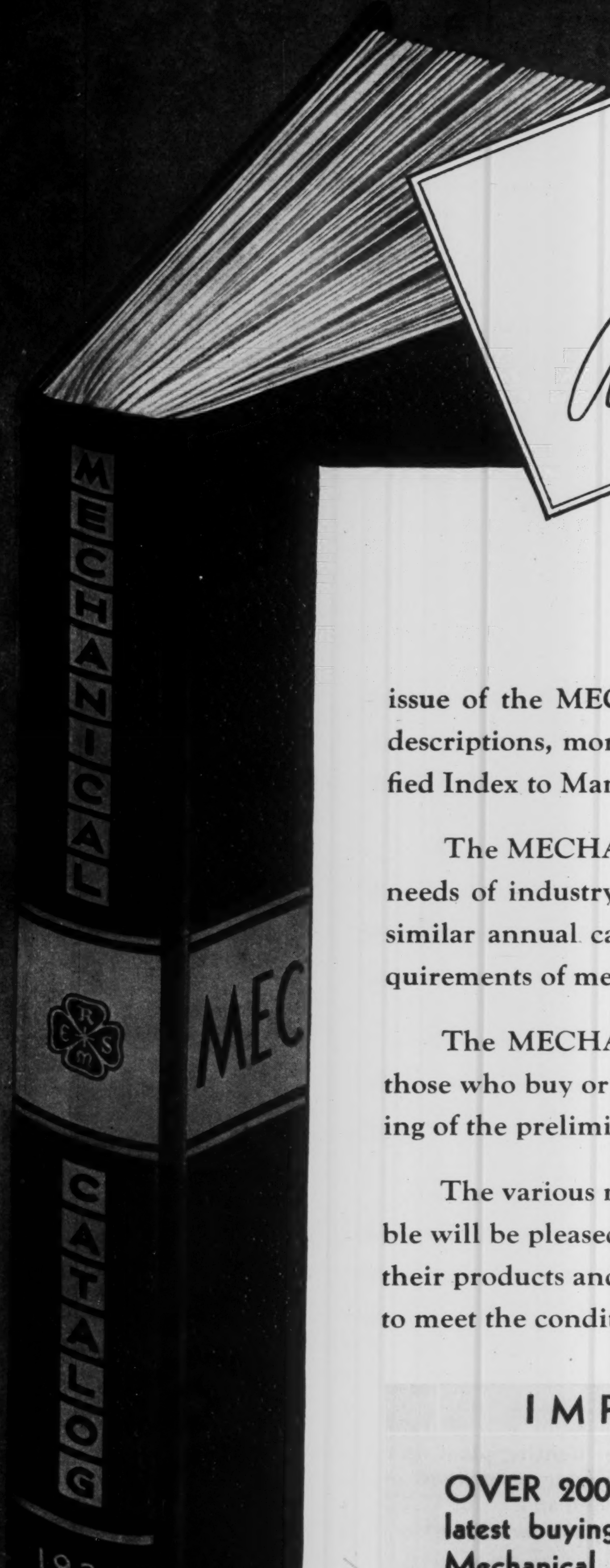
ROLLER BEARINGS

To A.S.M.E. Members



IMPROVED in format, this new issue of the MECHANICAL CATALOG has over 1,600 product descriptions, more pages than the preceding edition. The "Classified Index to Manufacturers" included lists over 850 firms.

The MECHANICAL CATALOG covers only the mechanical needs of industry. Compare its contents with like data in other similar annual catalogs and see how well this book meets the requirements of mechanical engineers.

The MECHANICAL CATALOG is a highly important aid to those who buy or specify for industry, since it saves time in disposing of the preliminary phases of such problems.

The various manufacturers who have made this service possible will be pleased to further acquaint you with the sales merits of their products and assist your company in making the best selection to meet the conditions involved.

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The American Society of Mechanical Engineers

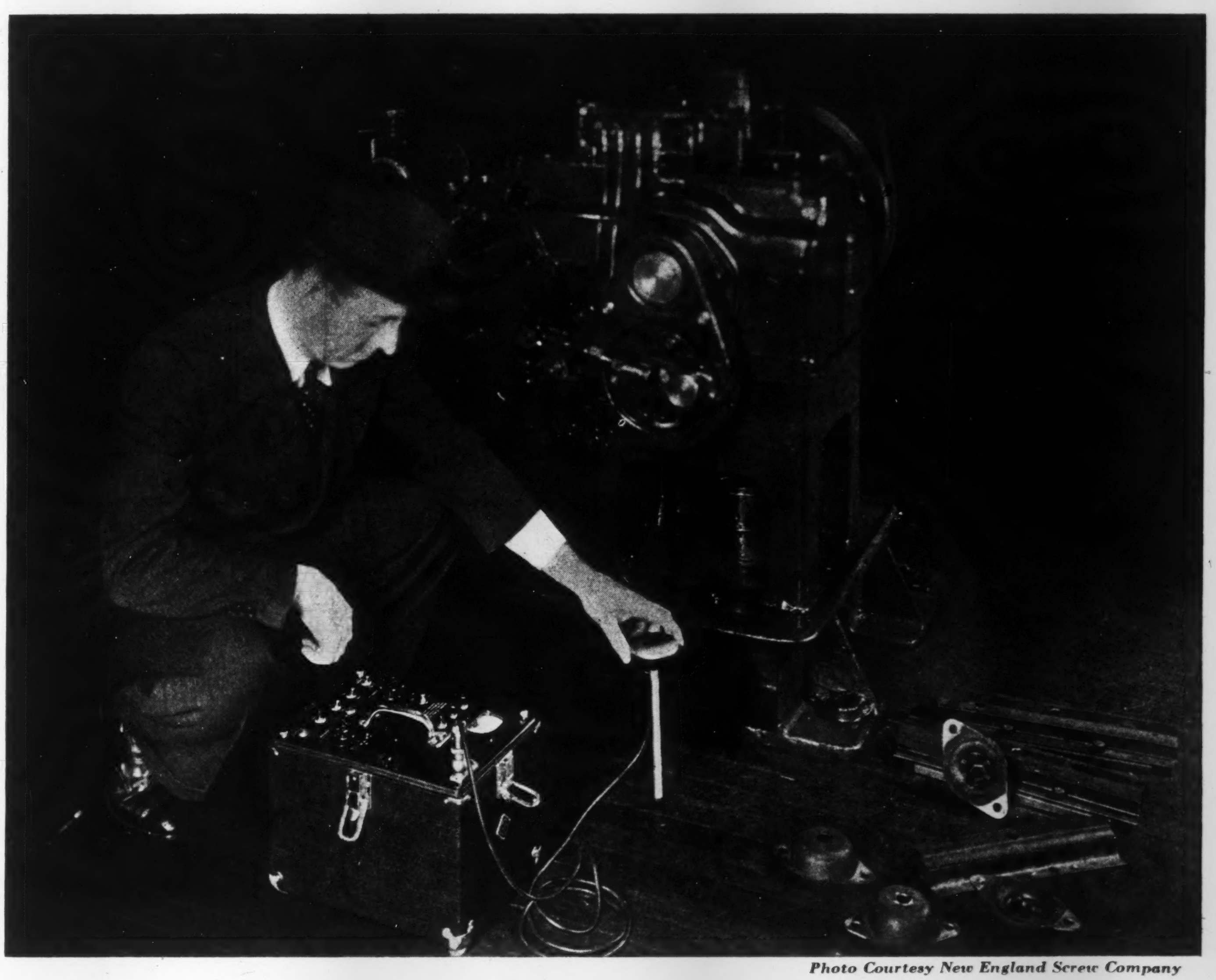

Photo Courtesy New England Screw Company

Eliminating Vibration

VIBRATION generated in the machine illustrated was sufficient to crack the underlying concrete floor. Oil seepage from the machine got into the cracks, permeated the floor and appeared as blotches on the ceiling below.

Measurements with the new General Radio Sound Level Meter (with a simple vibration pick-up) did three things:

1. **Located the source of vibration in the machine screw header.**
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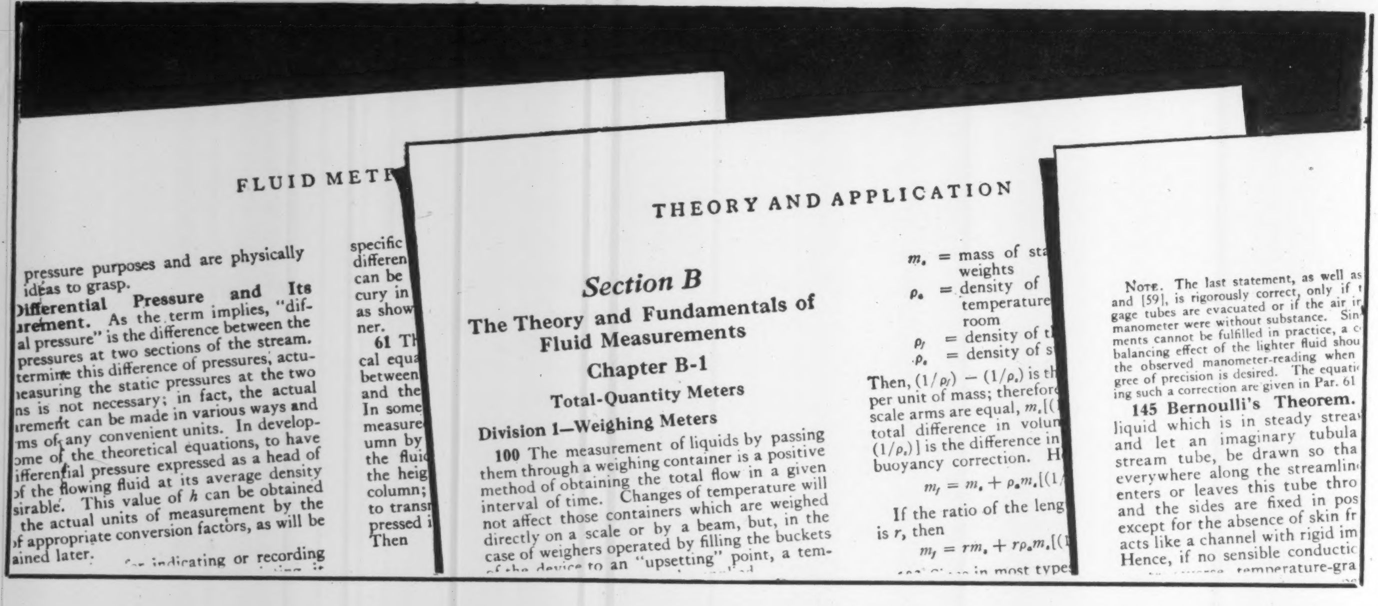

FLUID METE

pressure purposes and are physically
ideas to grasp.
**ifferential Pressure and Its
rement.** As the term implies, "dif-
al pressure" is the difference between the
pressures at two sections of the stream.
termine this difference of pressures, actu-
easuring the static pressures at the two
ns is not necessary; in fact, the actual
rement can be made in various ways and
ms of any convenient units. In develop-
ome of the theoretical equations, to have
ifferential pressure expressed as a head of
f the flowing fluid at its average density
sirable. This value of *h* can be obtained
the actual units of measurement by the
f appropriate conversion factors, as will be
ained later.
for indicating or recording

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THEORY AND APPLICATION

Section B

The Theory and Fundamentals of Fluid Measurements

Chapter B-1

Total-Quantity Meters

Division 1—Weighing Meters

100 The measurement of liquids by passing them through a weighing container is a positive method of obtaining the total flow in a given interval of time. Changes of temperature will not affect those containers which are weighed directly on a scale or by a beam, but, in the case of weighers operated by filling the buckets of the device to an "upsetting" point, a tem-

m_s = mass of st
weights
ρ_a = density of
temperature
room
ρ_f = density of t
ρ_s = density of s
Then, $(1/\rho_f) - (1/\rho_s)$ is th
per unit of mass; therefor
scale arms are equal, $m_s[($
total difference in volu
$(1/\rho_s)]$ is the difference in
buoyancy correction. H

$m_f = m_s + \rho_a m_s[(1/$

If the ratio of the leng
is r, then

$m_f = rm_s + r\rho_a m_s[($

in most type

Note. The last statement, as well as
and [59], is rigorously correct, only if t
gage tubes are evacuated or if the air in
manometer were without substance. Sin
ments cannot be fulfilled in practice, a c
balancing effect of the lighter fluid shou
the observed manometer-reading when
gree of precision is desired. The equati
ing such a correction are given in Par. 61

145 Bernoulli's Theorem.
liquid which is in steady strea
and let an imaginary tubula
stream tube, be drawn so tha
everywhere along the streamlin
enters or leaves this tube thro
and the sides are fixed in pos
except for the absence of skin fr
acts like a channel with rigid im
Hence, if no sensible conductic
temperature-gra

The Fourth (1937) Edition

Part 1—FLUID METERS, THEIR THEORY AND APPLICATION

Nothing quite so thorough as this Fourth edition has ever been published. It establishes a better understanding of fluid measurements, and provides users, designers, and manufacturers with up-to-date information on various meters, their design, coefficients, and general behavior.

This 1937 Report has been completely rewritten, while ninety per cent of its illustrations have been changed. For convenience of users the subject matter has been arranged as follows: A—in which the classification and nomenclature of fluid meters are given, B—dealing with the theory of fluid measurement, C—giving physical constants and meter coefficients.

Sections A and B constitute an invaluable treatise on measuring fluids. Here are set forth, in a comprehensive manner, steps taken in developing practical working equations from theoretical relations.

Section C is a new addition. It contains the data needed in making fluid measurements with head meters, the necessary figures and tables for the accurate solution of fluid measurement problems, and examples illustrating the proper use of the data. The values of the discharge coefficients of venturi tubes, flow nozzles, and square-edged orifices given, are the latest available.

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SUPPLEMENTARY REPORTS

PART 2—DESCRIPTION OF METERS

Prepared by the A.S.M.E. Special Research Committee on Fluid Meters and published in 1931, this Report discusses in detail the individual makes of meters which are in commercial manufacture. Descriptions cover, in the case of head meters, the primary devices manufactured for each type of meter as well as the secondary devices, or meters proper. There are 80 diagrams illustrating both the primary and secondary devices.

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PART 3—SELECTION AND INSTALLATION

Also developed by the A.S.M.E. Special Research Committee on Fluid Meters and published in 1933, this Report describes the important factors to be considered when deciding upon a meter for a particular service and indicates the proper installation. It treats of the location of the primary element and of the proper methods of transmitting the differential pressure from the pipe line to the secondary element.

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A.G.A.—A.S.M.E. REPORT ON ORIFICE COEFFICIENTS

The original Report of this joint committee was published in 1935. Recently the A.S.M.E. Special Research Committee on Fluid Meters secured permission to publish an edition of the report omitting the extensive supporting data. The publication which is now available contains:

- An outline of the history of the orifice meter in this country
- A short resume of the various researches conducted by the committees and other interested bodies
- An analysis of the data available
- Recommendations on the proper methods of constructing and installing concentric orifices
- A general discussion of the precautions to be observed in the use of orifices as meter devices, and the accuracy to be expected
- Information on effect of pulsating flow on measurements by an orifice
- Tables and curves of orifice coefficients

The Report is not only based on, but presents most of the available data, of merit, from tests of orifice meters made in the United States during recent years. As it gives both orifice coefficients and instructions for installing and using orifice meters, this Report should be of considerable value and assistance to any one interested in measuring fluid rates of flow.

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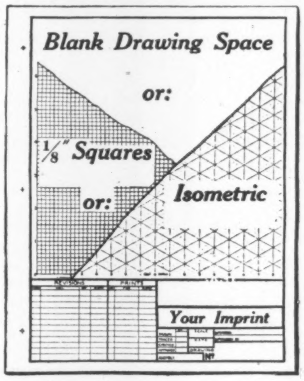

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2246 ME Brooklyn Station
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November, 1937 MECHANICAL ENGINEERING Vol. 59, No. 11
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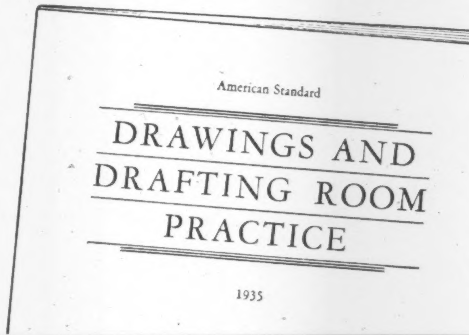
American Standard

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1935

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This standard was developed under the procedure of the American Standards Association, with the Society for Promotion of Engineering Education and The American Society of Mechanical Engineers as joint sponsors.

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Businesses For Sale
Partnership—Capital
Manufacturing Facilities

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Positions Open—Positions Wanted—Equipment, Material Patents, Books, Instruments, etc. Wanted and For Sale

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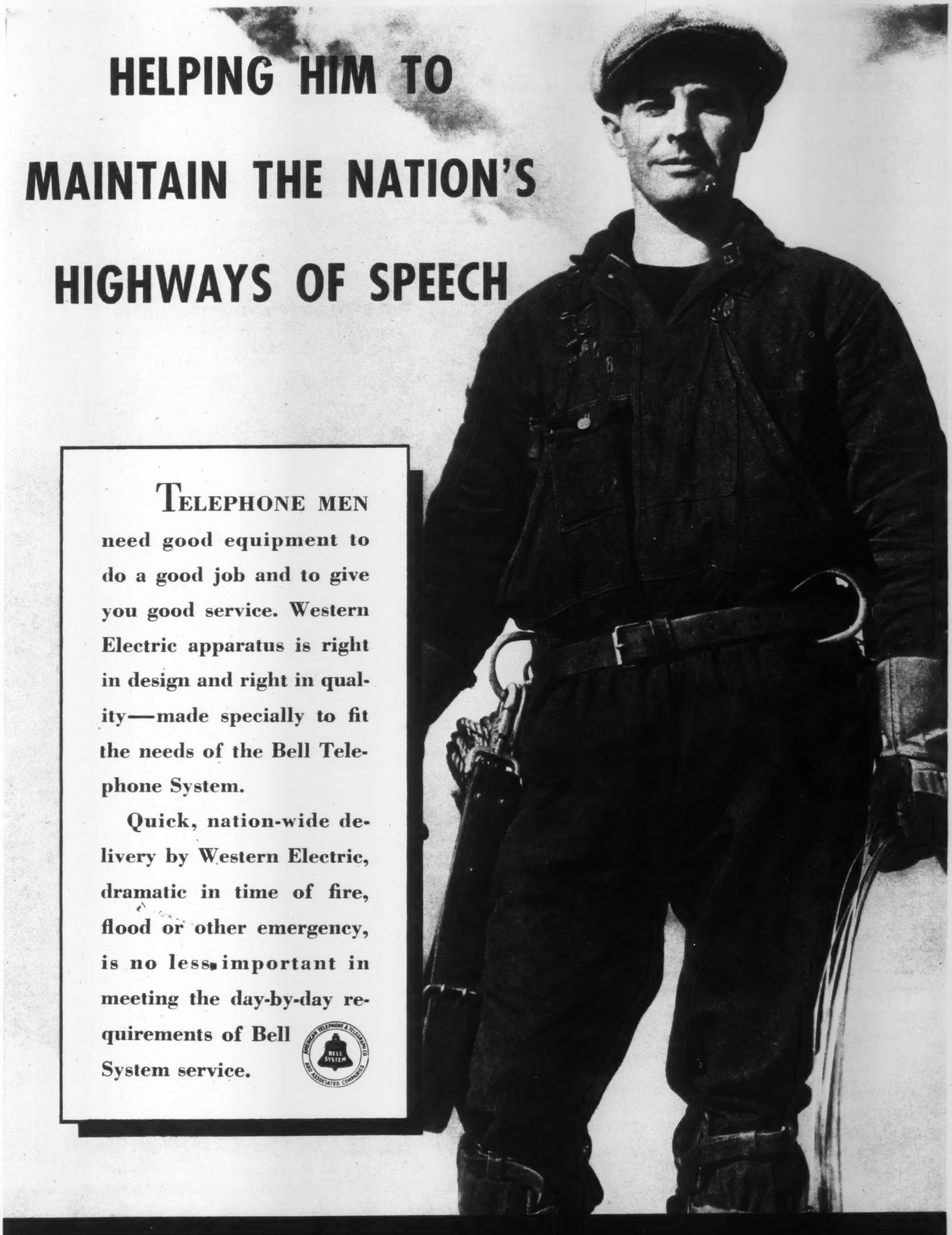
$2,500 to $25,000

This thoroughly organized advertising service of 28 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details. R. W. Bixby, Inc., 115 Delward Building, Buffalo, N. Y.

It will pay you to watch the announcements on this page for an opportunity that you may be looking for or one that may be of interest to you.



HELPING HIM TO

MAINTAIN THE NATION'S

HIGHWAYS OF SPEECH

TELEPHONE MEN need good equipment to do a good job and to give you good service. Western Electric apparatus is right in design and right in quality—made specially to fit the needs of the Bell Telephone System.

Quick, nation-wide delivery by Western Electric, dramatic in time of fire, flood or other emergency, is no less important in meeting the day-by-day requirements of Bell System service.

AMERICAN TELEPHONE & TELEGRAPH CO
BELL SYSTEM
AND ASSOCIATED COMPANIES

BELL SYSTEM SERVICE IS BASED ON *Western Electric* QUALITY

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The asterisk (*) indicates that firm has a product catalog in the 1937-38 MECHANICAL CATALOG

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Mechanical Engineering
close on the sixth of the month
preceding date of issue.

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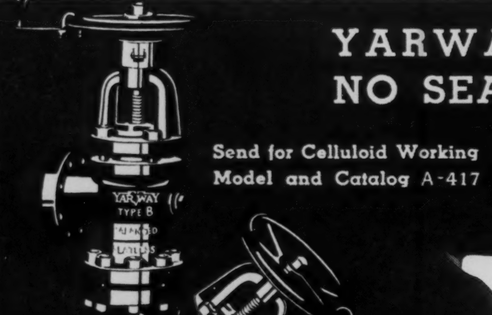
Air Preheater Co.	*G. M. Basford Co., New York, N. Y.*
Allis-Chalmers Mfg. Co.	*Stack-Goble Adv. Agency, Chicago, Ill.*
American Telephone & Telegraph Co.	*N. W. Ayer & Son, Philadelphia, Pa.*
Armstrong Machine Works	*Russell T. Gray, Chicago, Ill.*
Bakelite Corporation	*Rickard & Co., New York, N. Y.*
Barco Mfg. Co.	*Evans Associates, Chicago, Ill.*
Bristol Co.	*Rickard & Co., New York, N. Y.*
Charles Bruning Co.	*Buchen Co., Chicago, Ill.*
Buffalo Forge Co	*Melvin F. Hall, Buffalo, N. Y.*
Bundy Tubing Co.	*Holden, Graham & Clark, Detroit, Mich.*
Carnegie-Illinois Steel Corp	*Batten, Barton, Durstine & Osborn, New York, N. Y.*
Cleveland Worm & Gear Co.	*Paul Teas, Inc., Cleveland, Ohio*
Climax Molybdenum Co.	*N. W. Ayer & Son, Philadelphia, Pa.*
De Laval Steam Turbine Co.	*George H. Gibson Co., New York, N. Y.*
Diamond Chain & Mfg. Co.	*Kirkgasser-Drew, Inc., Chicago, Ill.*
Edward Valve & Mfg. Co.	*Commercial Adv. Agency, Chicago, Ill.*
Fairbanks, Morse & Co.	*Henri, Hurst & McDonald, Chicago, Ill.*
Garlock Packing Co.	*Hutchins Adv. Co., Rochester, N. Y.*
Hyatt Bearings Div.	*Campbell-Ewald Co., New York, N. Y.*
International Nickel Co.	*Marschalk & Pratt, New York, N. Y.*
Jenkins Bros.	*Rickard & Co., New York, N. Y.*
W. A. Jones Fdry. & Mch. Co.	*Kreicker & Meloan, Chicago, Ill.*
Leipzig Trade Fair	*Willdrick & Miller, New York, N. Y.*
Lovejoy Flexible Coupling Co.	*Merrill Symonds Adv. Service, Chicago, Ill.*
Marlin-Rockwell Corp.	*Everett L. Bowers, Buffalo, N. Y.*
Morse Chain Co.	*Fred M. Randall Co., Detroit, Mich.*
Norma-Hoffmann Bearings Corp.	*L. I. Wightman, New London, Conn.*
Permutit Co.	*Kenyon & Eckhardt, New York, N. Y.*
Philadelphia Gear Works	*R. E. Lovekin Corp., Philadelphia, Pa.*
Phosphor Bronze Smelting Co.	*R. E. Lovekin Corp., Philadelphia, Pa.*
John Robertson Co.	*R. E. Lovekin Corp., Philadelphia, Pa.*
Smooth-On Mfg. Co.	*A. Eugene Michel & Staff, New York, N. Y.*
Socony-Vacuum Oil Co.	*J. Stirling Getchell, New York, N. Y.*
Spring Washer Industry	*Neisser-Meyerhoff, Chicago, Ill.*
Standard Pressed Steel Co.	*R. E. Lovekin Corp., Philadelphia, Pa.*
The Texas Co.	*Buchanan & Co., New York, N. Y.*
Tube-Turns Incorporated	*Elmer H. Doe Adv. Agency, Louisville, Ky.*
Wilmington Fibre Spec. Co.	*R. E. Lovekin Corp., Philadelphia, Pa.*
T. B. Wood's Sons Co.	*R. E. Lovekin Corp., Philadelphia, Pa.*
Yarnall-Waring Co.	*McLain Organization, Philadelphia, Pa.*



YARWAY SEATLESS BLOW-OFF VALVES
NO SEAT TO SCORE, CLOG, WEAR, LEAK

More than 10,000 installations

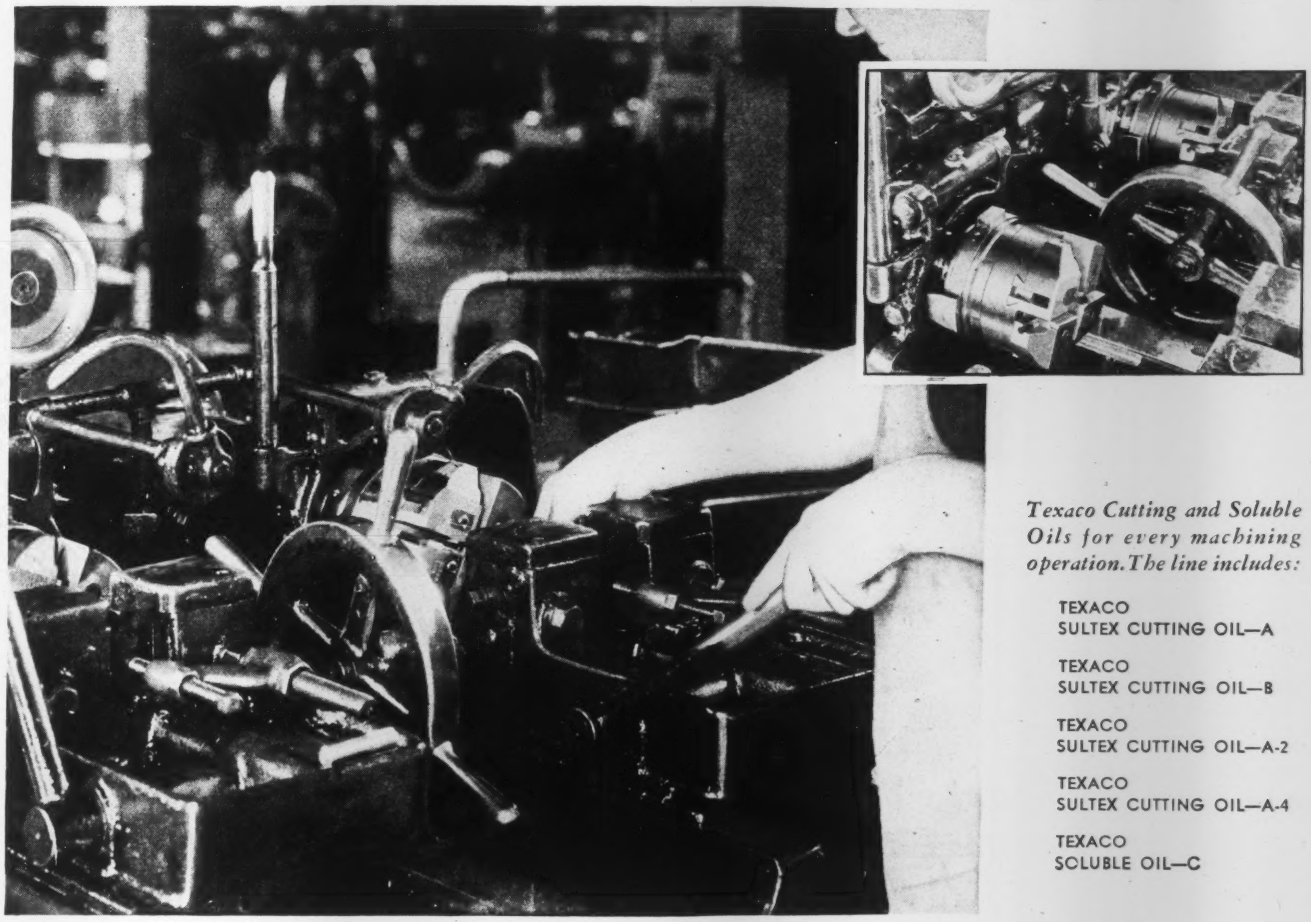
Send for Celluloid Working Model and Catalog A-417

YARWAY

YARNALL-WARING CO. PHILADELPHIA, PA.

Chrome-Nickel Studs..

CHASER LIFE INCREASED *167%*



Texaco Cutting and Soluble Oils for every machining operation. The line includes:

TEXACO
SULTEX CUTTING OIL—A

TEXACO
SULTEX CUTTING OIL—B

TEXACO
SULTEX CUTTING OIL—A-2

TEXACO
SULTEX CUTTING OIL—A-4

TEXACO
SOLUBLE OIL—C

These photographs show a Double-Head Landis Threading Machine . . . the type of machine on which the 167% increase in chaser life was recorded, threading chrome-nickel studs. Texaco Sultex Oils are recording similar increases in shops everywhere.

THE JOB was one of threading a large quantity of 3/4″ x 1 1/2″ chrome-nickel steel studs (SAE No. 3135) heat treated, in one of the plants of Russell, Burdsall & Ward Bolt and Nut Company.

Trying one cutting oil after another, the chasers stood up for an average of 1 1/2 hours between tool grinds. This was not enough.

The 13th cutting oil was then tried . . . Texaco Sultex . . . and output of the Double-Head Landis Threading Machine promptly rose from 1 1/2 hours average to 4 hours average. This increase of chaser life between grinds amounts to 167%. Texaco Sultex Cutting Oil penetrates, gets down between the chip and the tool, reduces friction, prevents abrasion, and smooths the work of the cutting edge.

Trained engineers are available for consultation on the selection and application of Sultex Cutting and Soluble Oils. Prompt deliveries assured through 2070 warehouse plants throughout the United States.

Let a Texaco engineer make a demonstration in your own plant. The Texas Company, 135 East 42nd Street, N. Y. C.

TEXACO

Sultex Cutting & Soluble Oils

HERE IS SOMETHING NEW

A SET SCREW THAT LOCKS ITSELF IN PLACE

Where can you use it?

UNBRAKO

SELF-LOCKING HOLLOW SET SCREW

Almost every industrial plant has need for set screws that can be turned tight and depended upon to stay put . . . Do you know of a need for them in your plant? We'll be glad to send you a sample "UNBRAKO" so that you can examine the knurling around the two top threads. This knurling raises sharp prongs all around the edge of the thread which dig right into the threads of the tapped hole when the "UNBRAKO" is being tightened up . . . thus it cannot possibly work loose.

Customers have already bought about 2,000,000 "UNBRAKO" SELF-LOCKING SET SCREWS. They agree that once they're tightened up vibration never loosens them.

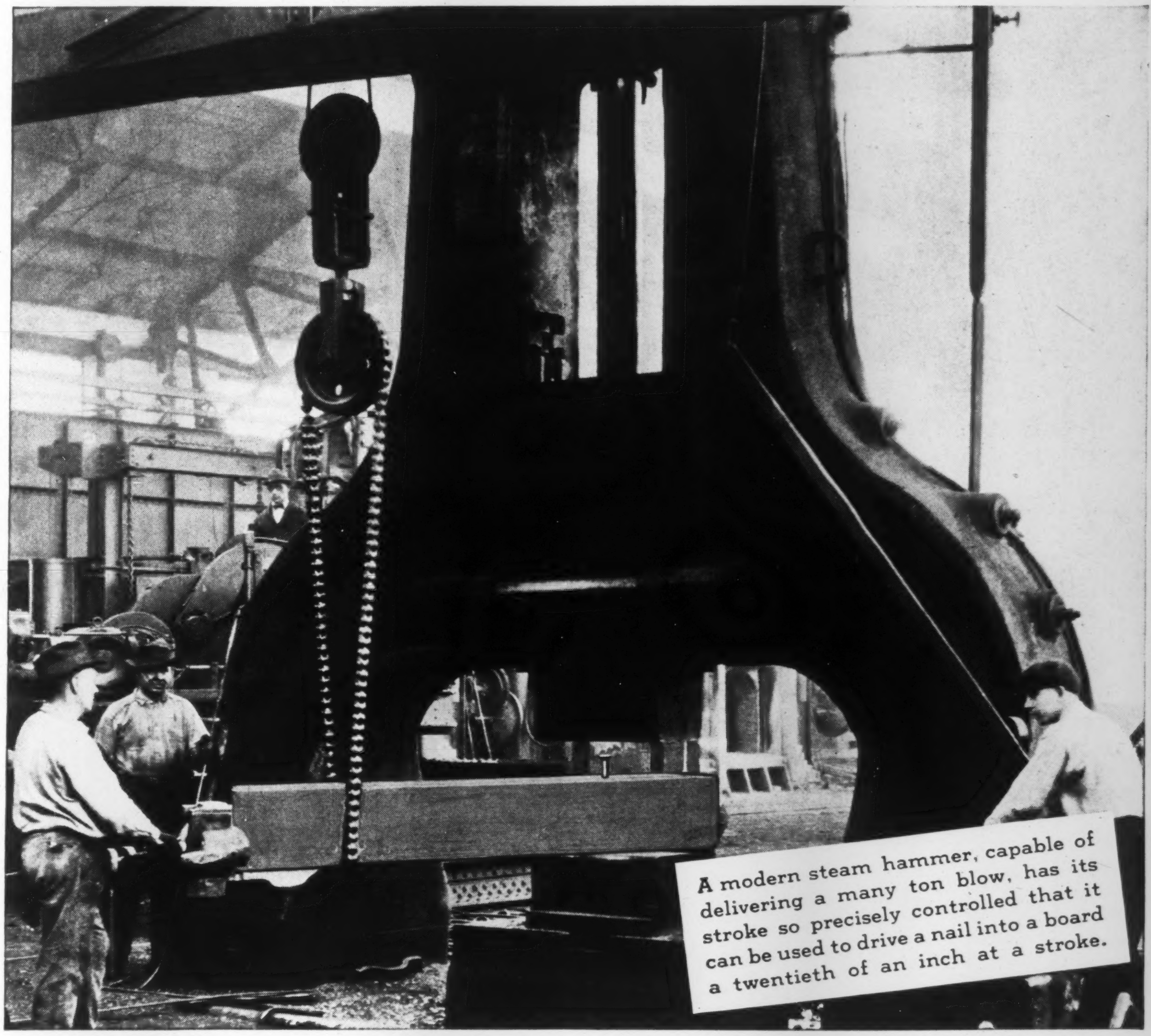
STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA. Box 558

BRANCHES
BOSTON
DETROIT
INDIANAPOLIS

BRANCHES
CHICAGO
ST. LOUIS
SAN FRANCISCO

ALL MACHINERY IS DEVELOPING SUPER-PRECISION



A modern steam hammer, capable of delivering a many ton blow, has its stroke so precisely controlled that it can be used to drive a nail into a board a twentieth of an inch at a stroke.

● In all machine tools, and especially those involving rotating parts, progress demands greater precision. Spindle rigidity in lathes, grinders, hobbers, drills and boring tools is largely dependent on the bearings. And as higher speeds and fine surface finish demand the rigidity and efficiency of ball bearings, future development of these tools depends on increased ball bearing capacity and accuracy.

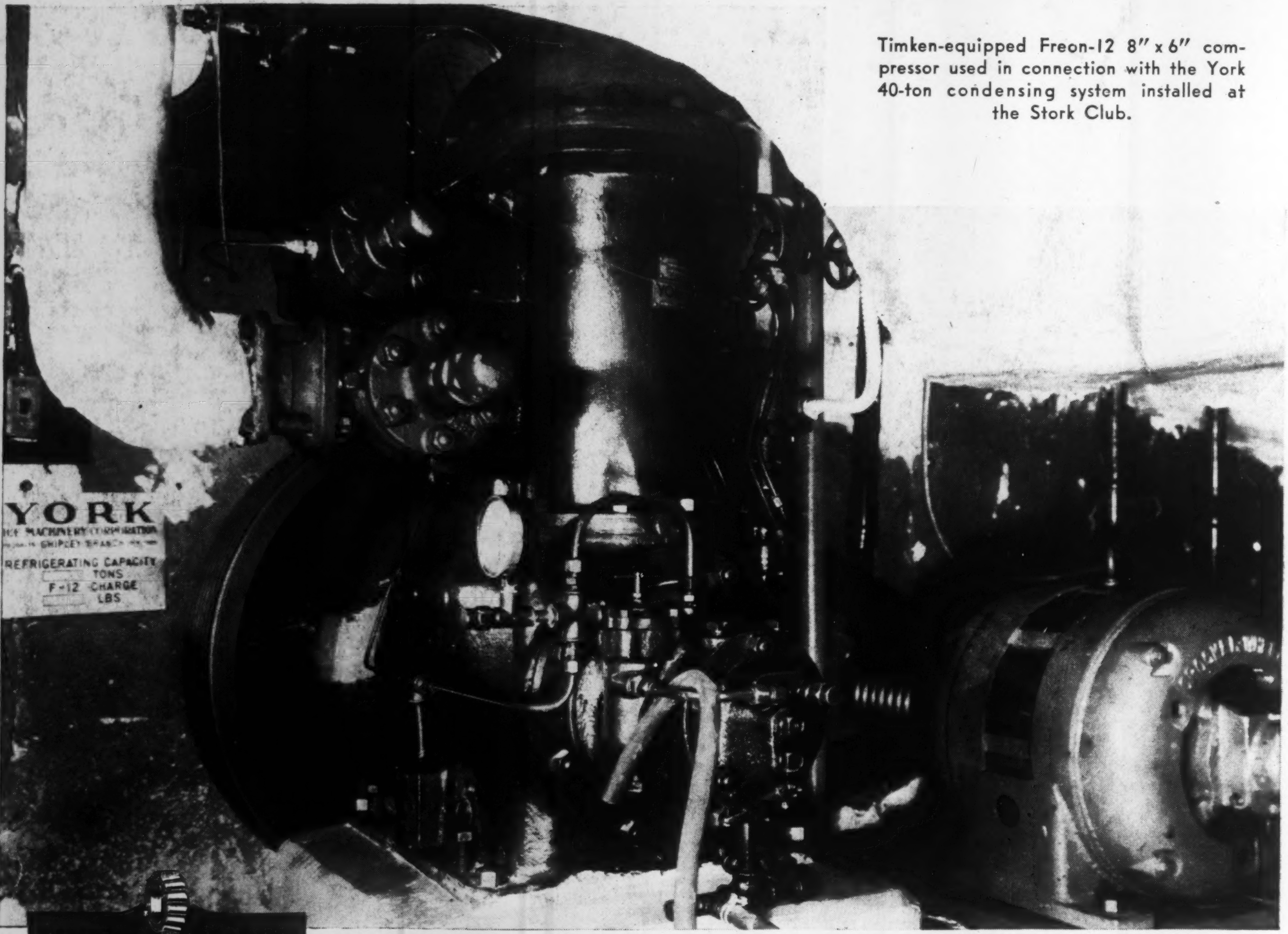
In M-R-C Super-Precision ball bearings extremely high accuracy is achieved. The outside diameter, bore and race grooves are held to concentricity tolerances of only a few 10,000ths of an inch. Ball diameters and sphericity are held within a few 100,000ths.

While the extreme accuracy of M-R-C Super-Precision Ball Bearings is not necessary in all M-R-C Bearings, the quality and precision of all M-R-C Ball Bearings reflect the methods developed to attain Super-Precision accuracy. Every M-R-C Ball Bearing is a better bearing than it would be if M-R-C Super-Precision Bearings did not exist.

MARLIN-ROCKWELL CORPORATION
Executive Offices: JAMESTOWN, N. Y.
Factories: JAMESTOWN, N. Y. . . . PLAINVILLE, CONN.

M-R-C SUPER-PRECISION BALL BEARINGS ESTABLISH NEW STANDARDS OF ACCURACY

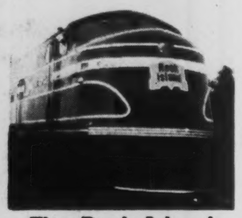
M-R-C *Ball Bearings*
GURNEY ● SRB ● STROM



Timken-equipped Freon-12 8″ x 6″ compressor used in connection with the York 40-ton condensing system installed at the Stork Club.

A symbol of quality for any piece of equipment with which it is associated

AT NEW YORK'S SMART
STORK CLUB



The Rock Island "Rockets" Roll On TIMKEN Bearings

GLIDE—as you ride a Timken-equipped train

Modern air conditioning is just as desirable in the fashionable night spots as it is in offices, stores, factories, theaters or any other place where people work or play.

A fundamental quality of all air-conditioning equipment—wherever it may be installed—is dependability. In any refrigerating system the compressor is the key to dependable performance, economy, low maintenance cost and long life. Mounting the crankshafts on TIMKEN Bearings assures better operating compressors because friction is eliminated; crankshaft wear is prevented; crankshafts are fully protected against radial, thrust and combination loads; and permanently held in exact alignment.

When buying air conditioning systems or individual compressors of any type—air or gas—it will pay you to ask this question: "Is the crankshaft Timken-equipped?" and be guided by the answer.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; Timken Rock Bits; and Timken Fuel Injection Equipment.

TIMKEN
TAPERED ROLLER BEARINGS